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EDITORIAL.

Padi Experiments. In the last number of this Journal we published a review of field experiments on padi. The article included brief notes on the history and present position of this work, modifications and investigations in respect of standard procedure which had been found necessary as the investigations proceeded, and the results of manurial and cultivation trials in the 1939 - 40 season.

The author stated that his object was to review the ground covered up to the present by field experiments on padi and, in respect of selection and tests of pure strains and their distribution, to recount results in sufficient detail to provide a reliable register for reference. The article in the last number of this Journal was therefore introductory to the review of the work at the numerous centres in Malaya during the past few years which forms the subject of the principal article in the present number.

In breaking away from our usual review of the past season only, we provide an opportunity for viewing the work in better perspective. The complexities of the problems have to some extent been unravelled by the investigations to date, but we are fully aware that some of the major problems of padi cultivation still await solution. Continuity of policy in these experiments with sufficient elasticity to provide for the varying conditions in different areas is the keynote to ultimate success, and it is believed that the present policy, which has been carefully re-examined after some seasons, is adequate to ensure efficiency.

Sensationalism in Agriculture For some time past there has been a noticeable tendency to introduce a note of sensationalism into agriculture, or to be more exact, into reports on the application of science to agriculture. Reports find currency of new or improved methods which, it is claimed, are likely to revolutionize agricultural practice.

It is unusual for the research worker to make extravagant claims for his work; he is usually content to indicate the road and leave its exploitation to commercial enterprise. Nor is the capitalist generally responsible for undue sensationalism; he may extol the virtues of his product, but he realizes that extravagant claims usually defeat their object, for failure to come up to claims made prejudices the article in the eyes of the public.

It is more than likely that this sensationalism is fostered by a section of the press in an endeavour to meet the thirst of the less informed public for information in "tabloid form" on a wide range of subjects. The basis of the claim may be but a half-truth gathered from the investigator's work. For instance, remarkable yields are possible in pot culture experiments, but to translate these yields into terms of tons per acre as a practical proposition may be entirely misleading.

However, we do not wish to press an accusation for sensationalism in any particular quarter, but rather to invite agriculturists to be discriminating in their acceptance of claims for improved methods. A sensational new discovery is possible at any time and the agriculturist would desire to take early advantage of such discovery. He may save time and money if he seeks advice in such matters before launching into seas unknown to him. In the agricultural services throughout the Empire and also in most other countries, exists a chain of organizations competent to ensure that the farmer, the planter and the peasant alike may be given the best advice. It may be that scientists will sometimes offer conflicting advice, but it will generally be the case that they will be unanimous in trying to deter the farmer from accepting claims which are of doubtful value, which they consider to be unproven, or which although intrinsically true may be uneconomic.

Although the agriculturist more usually now turns to the scientist for advice than was the case a few years ago, he still fails to make the fullest use possible of the services of agricultural organizations established—often by the planter himself—for this very purpose.

Most agricultural institutions publish journals in which they present not only the results of their own investigations, but the results of research work in other countries that have a possible bearing on agricultural practice in their own area; they also frequently short circuit or anticipate enquiries. It is suggested that fuller use of such publications would tend to engender a balanced attitude which would render readers of a sensational article better able to evaluate claims made at their proper worth.

Original Article.

A REVIEW OF FIELD EXPERIMENTS ON PADI IN MALAYA

By
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In my introduction to the article in the last number of this Journal I undertook among other things to recount the results of selection, tests of pure strains and their distribution, in sufficient detail to provide a reliable register for reference.

In this article an endeavour has been made to fulfill that undertaking though discrimination has been used in order to avoid recording unnecessary data. Thus, whilst detailed lists of selections made and strains tested are given for certain Stations, they are omitted from other Stations where experience has shown that future work must of necessity be concerned with selection from local varieties and a record of past yields of introduced strains would serve no useful purpose.

A Review of Selection and Comparative Yield Experiments on Padi Stations and Records of Distributions.

The following accounts have been contributed by Departmental Officers in the various States and Settlements or are compiled from information supplied by them.

The arrangement is the same as in previous accounts of each season's work and is roughly geographical from north to south.

KEDAH.

Approximately 265,000 acres of Padi.

Telok Chengai. The Station is situated on medium alluvial clay with a variable layer of old sea shells at 3 to 5 ft. beneath the surface. It is largely dependent upon rainfall for its water, particularly as regards initial flooding, but it is nevertheless early, sowing generally being possible in June or at the beginning of July. Varieties of more than 6 months maturation period are not as a rule very successful.

The Station has produced such successful strains as Mayang Ebus 80 and 88, Radin China 4 and 17, and Reyong 6 and 20. The varieties Chubai, Radin Che Nah, Chempa Puteh, Konchor, and Kala have also undergone selection in the past but the only strain of possible value from all these was Chubai 18. The three best strains of Te'Seman have been returned to Langgar for Latin Square trials.

Ear-to-row trials were continued on Mayang Tekai (16 lines) Serendah Sungai Dua (19 lines) and Raja Muda (8 lines). Mayang Tekai being a rather long-term variety suffered from severe drought before flowering and the results were valueless.

The other two varieties except for the three outside lines of S.S.D. were attacked by *Sclerotium oryzae* (*penyakit kisar*) with the result that no comparisons were possible. Preliminary selections of Anak Didek were made.

A 6-way Latin Square was laid down primarily designed to observe any differences in susceptibility to *S. oryzae*. Mayang Tekai (unselected) was markedly inferior to the other varieties owing to drought, but otherwise the experiment yielded no information of value.

JITRA. The Station is situated on alluvial clay, and adjoins a dam in the Jitra canal. The land is typical of the deeper clays in the Kubang Pasu District, most of which were previously under thick heavy jungle. The Station has decidedly proved its worth.

The strains under trial in two Latin Squares were Sm. 29, Sm. 76, M.E. 80, M.E. 88, Rey 6, Rey 20, R.C. 17 with Anak Kuching as a local comparison. During this season all strains did well with the exception of R.C. 17 which only equalled the local variety. For a change the Reyongs escaped rat damage and did well. From past experience Sm. 29 and M.E. 80 are the most reliable strains though the former is a comparative newcomer.

PADANG PERAHU. This Station represents the shallow clay often overlying lateritic formations typical of the poorer areas in Kubang Pasu; it is entirely dependent upon rain. This was its second season and it has not yet proved its value.

Varieties under trial in one Latin Square were Sm. 29, M.E. 80, R.C. 4, and R.C. 17, with Selindang Gunong as the local comparison. All selected strains were again markedly superior to the local variety; R.C. 17 was inferior to the other three.

LANGGAR. The Station is situated on light clay and depends entirely upon rainfall. It is typical of large areas inland from the coastal alluvial plain, and has definitely proved its worth.

Varieties under trial were Sm 29, Sm 76, M.E. 80, M.E. 88, R.C. 4, R.C. 17, Rey 20, To'Seman 35, T.S. 42, T.S. 103 and Subang Intan as the local comparison. N. 10 has been discarded from this Station because in spite of its high yields it was not popular among the rayats.

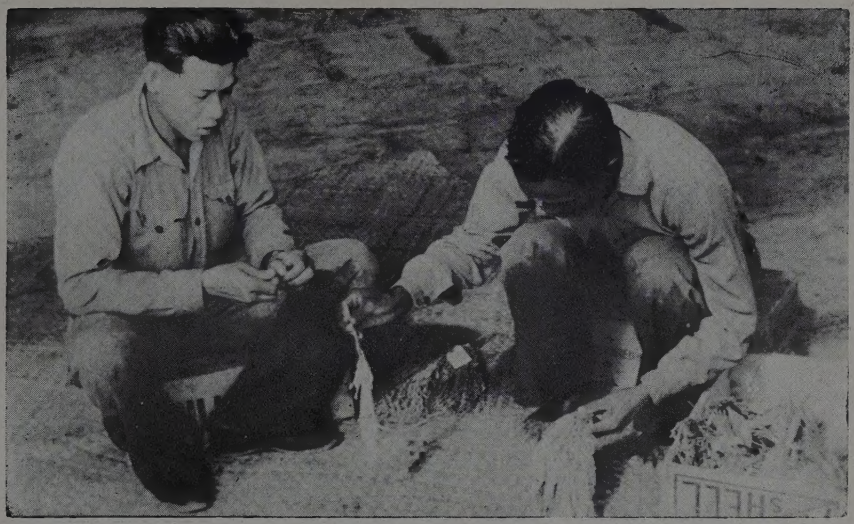
Sm 29 and M.E. 80 proved to be the best strains, and it is unlikely that any of the To'Seman lines will come up to their standard. To'Seman lines were all statistically inferior for the third year in succession, but as the variety is far famed for its eating qualities it is probable that the strains will be taken up on a small scale.

During this season preliminary selections of Subang Intan were made.

A collection of 42 local varieties was grown in lines for herbarium and nomenclature purposes; several of these varieties proved to be selected strains which had been given *kampong* names.

SALA KANAN. This Station is situated on coastal alluvial clay entirely dependent upon rainfall. It is typical of the southern portion of the main plain, but is rather later in getting water than much of the surrounding land.

SELECTED EARS FOR SOWING.



All the ears are from bagged plants and the best two are selected to obtain 60 strong plants

SOWING THE SPROUTED SEED.

The seed is sown still in the ear to eliminate any chance of mixing.

NURSERY OF SELECTED STRAINS.

Age approximately one week.

NURSERY OF SELECTED STRAINS.

Seedlings one week old.

Varieties under trial were Sm 29, Sm 76, M.E. 80, M.E. 88, Rey 20, Rey 6, R.C. 4 and R.C. 17 with Mayang Pasir as the local representative. Two Latin Squares are normally planted. The best varieties have proved to be Sm 29, M.E. 80 and R.C. 4, but it is impossible to place these in any definite order.

RANTAU PANJANG. The Station is situated on shallow clay typical of large areas in the Kuala Muda District. It is entirely dependent upon rain, and is generally later than the Stations in North Kedah: it is occasionally subject to flooding from the Muda river.

The varieties under trial are Sm 29, Sm 76, M.E. 80 and 88, R.C. 4, Rey 6 and 20 with Anak Didek as the local type. Sm 29, M.E. 80 and M.E. 88 are the best strains with slight evidence over the last three years that M.E. 88 may be the best.

PULAI. The Station is situated on a soil containing rather a high proportion of sand, but it is typical of much of the land in the Baling District. It is dependent upon rain for its initial flooding but later on water can be obtained from a stream. Dry nurseries are used in conformity with local practice.

Varieties under trial are M.E. 80, R.C. 4 and 17, and Sm 29 with Serendah Sungai Dua as the local comparison. In general, selected strains have been regularly better than the local variety, and M.E. 80 has been by far the most consistent.

SIK. Situated on a light inland valley soil, and can be irrigated from a stream. Its institution should eventually provide a much needed stimulant to padi growing in the district.

Varieties grown were Sm 29, M.E. 80, R.C. 17 and the local Padi Pahit. A 4-way Latin Square was planted, but not analysed because by an oversight the yields were only measured and not weighed. Sm 29 and the local variety were about on a par and may have been better than the other two.

KULIM. Situated on a light inland soil which can be irrigated. It has yet to prove its value.

Varieties grown were Sm 29, M.E. 80, To'Seman 42, Nachin 10 and local Masir. No Latin Squares were laid down, but in multiplication plots the first and last named varieties did best.

LANGKAWI. The Station is situated on light rather sandy soil typical of padi land conditions in the island. Trials were a failure owing to drought.

Distribution.—Distribution of selected strains in North Kedah has been on a very extensive scale, and has been fostered by competitions. It is estimated that in Kubang Pasu some 17,000 acres were planted with either Sm 29 or M.E. 80 during the season under review; in the Langgar district the figure is put at 11,000 acres. Around Tokai R.C. 4 and 17 have become so popular that about 75 per cent. of the land is planted with one of these strains. In these districts Sm 76 and N. 10 have been given up by local growers, the former on account of poor yields,

the latter because of its weak straw. The southern part of the main plain has not yet been subjected to such propaganda as in the north, but Sm 29, M.E. 80 and R.C. 4 are in demand, and a few people ask for the Reyongs because of their good eating qualities.

In other areas M.E. 80 is rapidly becoming popular around Baling, while at Kuala Muda Sm 29 is finding favour. At Langkawi Sm 29 and N. 10 are beginning to spread.

PENANG AND PROVINCE WELLESLEY.

Approximately 37,000 acres of Padi.

BUKIT MERAH. The Station is centrally placed in an area of about 24,000 acres of plough land in Province Wellesley North and Central. The soil is a medium heavy clay, typical of the area, and a supply of irrigation water is available. The Station may reasonably be said to represent all the plough land which habitually receives sufficient water.

Varieties tried:—Rey. 6, 20, M.E. 203, 80, 88, 209. Nachin 11, 66, M.P. 148, Radin China 4, Sm. 29, C.O. 2, 5, 7. Unselected Konchor, Pator, and Anak Didek were also used in trials.

Of the varieties tried M.E. 80 and Rey 6 were found to be the highest yielding. Rey. 6 was eventually discarded for unevenness and new seed has been obtained from Telok Chengai Station, while M.E. 80, when planted in *ketua* plots, showed a strong susceptibility to *penyakit merah*. Several S.S.D. and M.T. varieties recently obtained from Kedah show promise. Local varieties were not sufficiently explored in the past but selection has now started on three popular local varieties, Konchor, Pator and Anak Didek, and seed will be sent to Telok Chengai, Kedah, for ear-to-row lines.

No large distribution of seed has yet been made in the area, but Siam 29 has been a popular variety in some districts on account of its satisfactory yield and good quality. M.E. 203, lower yielding but not so susceptible to *penyakit merah* as M.E. 80, has also found favour in certain localities as a variety which stands well and yields consistently.

SUNGEI ACHEH. The Station is situated in the centre of the Sungei Acheh area which is geographically a part of Krian. The soil of the Station is a deep coastal clay and is typical of the Sungei Acheh area (4,170 acres).

Varieties tried:—S. 48, 15, 36, 146, 371, M.K. 48, Machang 42, M.S.B. 5, 6, 8.

M.S.B. 8, M.K. 48 and S. 371 have been the highest yielders, but M.K. 48 has poor milling quantities.

S.K. 48 is widely grown in the area owing to its consistently satisfactory (though not outstandingly high) yield and the fact that a premium was obtainable at the Perak Government Rice Mills.

SEED LINES.

Three or four lines are planted to provide a source of pure seed. The outside lines are discarded while seed is obtained from the inside plants only.

VIEW OF TITI SERONG PADI EXPERIMENT STATION AT PLANTING TIME.

Seedlings tied in bundles ready for planting in foreground.

PLANTING THE STRAINS UNDER SELECTION.

Each line is planted separately and then the remainder is removed. Every tenth plant is then discarded and replaced by a "standard."

STRAINS UNDER SELECTION.

Planting completed.

GENTING. This Station is situated centrally in the padi areas of south-west Penang and in its soil (deep clay) it represents well the padi fields on this side of Penang.

Varieties tried:—S. 48, 15, 36, 146, 371, M.K. 48, M.S.B. 5, 6, 8.

M.S.B. 8, M.K. 48 and S. 371 have so far been the highest yielders.

No large scale distribtuion of seed has yet taken place as this Station has only been operating for 3 years.

PERAK.

Approximately 108,000 acres of Padi.

TITI SERONG. This old established Station, situated in the Krian Irrigation Area, occupied by the Division of Economic Botany in 1916, is the source of origin of many high-yielding strains distributed by the Department. The Field Branch assumed control of the Station in 1932, when an Agricultural Officer was stationed at Parit Buntar. The Station is 17 acres in extent, and placed in an area of first-class land, which usually yields between 400 and 500 gantangs of padi per acre. An excellent water supply is available from the Sungei Acheh canal, but drainage is poor.

In 1932 there was a large collection of miscellaneous strains, known as 'Foundation Stocks.' These comprised a numbered series of single plant selections originating from various parts of the country and totalling 53 lines. Certain of these were discarded and the more promising retained for further field trials. Of these, Mayang Kuning 48 and Machang 42 were among the best of the long-term strains. Machang 42 was the only representative then remaining of 28 selections made from the progeny of a few coloured 'Machang' segregates among Seraup Kechil 36 in 1929.

In addition there were selections of Seraup and Radin, which contained several high-yielders. The most important of these were Seraup Besar 15, Seraup Kechil 36, 48, 146, 371 and Radin 4, 7, 11 and 13. Of the Radins, the two former have reddish husks whilst the two latter are yellow.

Later selection work at Titi Serong may be divided into two categories: (i) work of immediate value to Krian District itself, and (ii) work undertaken for other districts.

Of the former, selection of local Machang and Seraup for the heavy-yielding areas in north-west Krian, consisting of some 15,000 acres of fertile land, Serendah for the peaty and low-lying areas, and Seri Raja for the high lands of south Krian, was undertaken. The total area served amounts to over 51,000 acres of padi fields. These selections have not yet been in progress sufficiently long for any strains to be fully proved. In addition, a selection of Bujang was made but none was outstanding and all had equally poor straw, and were, therefore, discarded in favour of Seraup Besar 15 which they resemble.

The selection of strains for other districts has included Tongkat, of which T. 2, 7, and 10 are promising; Machang 2, 5 and 10, of which Mch. 2 is a consistently high-yielder; Serbok Mas, none of which was considered worthy of retention since this beautifully coloured but narrow-grained Radin type did not appear to possess great potentialities. These strains were selected for use in Larut District.

Selection of Chantek Puteh and Merah was undertaken for Upper Perak, but as these varieties are unsuited to Krian conditions, they were transferred to Talang Station.

Mayang Sa'Batil selections from Province Wellesley were also undertaken. The first was from a prize winning exhibit at the All-Malayan Padi Competition held at Kuala Lumpur in 1934, and has given three very good strains, *i.e.* M.S.B. 5, 6 and 8. A second selection made on a wider basis comprised 65 strains of which 40 remain.

A selection of Seraup from Negri Sembilan, received in 1938, is also under trial.

During the 1939-40 season water conditions were satisfactory and planting was carried out according to programme. The drought during January and February caused the fields to dry out completely, a very unusual occurance at this Station. Yields were well above average.

Strains of the following varieties were under trial:—

Machang. The last eight Machangs from the original 26 strains were tested in two Latin Squares; two were discarded on yield, the straw of a third was weak, and the remaining five, *i.e.* Mch. 51, 61, 63, 64 and 66 were retained.

Seraup. A total of 55 lines was grown from the original number of 81, but many are not true Seraup Kechil as they approach Seraup Besar or even Mayang Sa'Batil in type. Some yielded well and 30 strains have been retained for field trial.

A general account of the growth in popularity of Seraup Kechil 48 in Krian, and the selection of further strains of this and other varieties was recently published in the *Malayan Agricultural Journal*, Vol. XXVIII, p. 429. Of the 1940 harvest, 251,000 piculs received the bonus which the Government Rice Mills pay for pure strain Seraup Kechil 48. This represents 82 per cent. of the total padi bought by the Mills during the season and 37 per cent. of the total padi grown in Krian District during the year.

Tests with Seraup Kechil 48 and 371 were continued and results of trials over six seasons are now available. These are as shown in the following table.

Strain.	Yields in lbs. per acre.							Percentage of S.K. 48
	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	Average	
S.K. 48 ...	2640	2050	1930	2170	2010	2290	2181	100
S.K. 371 ...	3210	3150	2760	2390	2200	2280	2665	122

BAGAN SERAI TEST STATION.

Planting strains for field trial.

EXAMINING PLANTS IN THE FIELD AND RECORDING THEIR CHARACTERS.

Note the plant bagged to ensure that the seed is 'selfed': usually two plants per line are bagged.

FLOWERING OF STRAINS UNDER SELECTION.

Bagging to ensure 'selfing'.

DRYING THE HARVESTED PADI.

Note the crop from the varietal plots in sacks, that from the strains under selection still in ears, and the tillers removed whole for detailed examination.

Seri Raja. Twenty lines were grown out of the original 36, of which 12 are kept for further trial.

Serendah. Eight lines remain out 13. Of these Ser. 61 is outstanding, and Ser. 54, 58, and 59 are also being retained.

Mayang Sa'Batil. (Province Wellesley). From the original 15 strains, M.S.B. 5, 6 and 8 were again tested. Yields in Latin Squares during the past three years are as follows.—

Strain.	Yields in lbs. per acre.				Percentage of S.K. 48.
	1937-38	1938-39	1939-40	Average.	
M.S.B. 5 ...	2490	2560	2740	2597	136
M.S.B. 6 ...	2480	2600	2680	2587	135
M.S.B. 8 ...	2510	2530	2740	2593	136
S.K. 48* ...	1935	1920	1860	1912	100

* Standard.

Of the second selection of Mayang Sa'Batil the original 65 lines were again grown and some are promising, 45 strains being kept.

Chantek Puteh and Merah (Upper Perak). The original 21 lines of these attractive padis continued to be disappointing under Titi Serong conditions and their trial was discontinued, this being left to Talang Experiment Station.

Seraup (Negri Sembilan). The five original lines were grown. All have long whippy straw which lodges easily but they are retained for another season. The grain is stated to be of the normal type but with colourless tip and producing rice of unusual uniformity .

TALANG. This Station, approximately 29 acres in area of which 24 acres are under padi cultivation, together with the Test Station at Bruas, serves a total area of 23,540 acres of padi land in the Districts of Dindings, Kuala Kangsar and Upper Perak. The Field Branch first assumed charge of this Station in 1924. Although conveniently situated within a mile from the centre of Kuala Kangsar town, the Station has suffered vicissitudes owing to an unreliable water supply which is drawn from a temporary dam on the Kangsar river.

Preliminary selection of Radin Che Mah was made during the season 1935-36, grown from seed collected from plants in Kuala Kangsar District. This variety is a popular padi and planted extensively throughout the district, particularly at Padang Rengas. A series of 31 selections was made and has been grown in lines for four seasons. A number of these strains are being tested in Latin Squares during the 1940-41 season.

Padi Chantek was selected from Lenggong district, and 500 plants each of Chantek Puteh and Chantek Merah were planted for preliminary selection at Lenggong Test Station (now closed) during the season 1935-36. A total of 14 strains of Chantek Puteh and 7 strains of Chantek Merah were chosen and transferred to Talang for further selection. This series of strains was sent to Titi Serong Experiment Station in 1937 for parallel selection but after three years trial was found unsuited to Krian conditions. The most promising of these have been planted in Latin Squares in the 1940-41 season.

The original strains of Mayang Ebus, planted at Talang were M.E. 202, 203, 208, 209 and 210, and of these all, except M.E. 208 and 209, have been tested in Latin Squares since 1935-36 season, and showed no significant differences in yield. During the 1934-35 season, a new selection was undertaken in Province Wellesley and a total of 33 strains was obtained. A series of six strains, *i.e.* Mayang Ebus 10, 11, 13, 23, 30 and 32 was received at Talang for planting during the 1937-38 season. The most promising of these were tried in Latin Squares in 1937-38 and subsequent seasons. No significant difference was apparent between yields of these strains and Mayang Ebus 203 from the original selection, which was used as a standard. The results obtained are shown in the following table:—

Strain.	Yields in lbs. per acre.				Percentage of M.E. 203
	1937-38	1938-39	1939-40	Average	
M.E. 203 ...	3320*	3410*	2950*	3227	100
M.E. 10 ...	3590*	3250*	2880	3213	100
M.E. 11 ...	3460*	3530*	3070	3353	104
M.E. 13 ...	3550	3670	3190	3470	108
M.E. 30 ...	3340	3220	2870	3143	98

* Average of 2 plots.

TANJONG PIANDANG. This Station was opened in the 1938-39 season in the Kuala Kurau Extension Area, which consists of some 4,000 acres of mangrove swamp. This is on the seaward side of the Krian Irrigation Area, and is now being opened up for cultivation. The Station, which is supplied with good irrigation, consists of 6 acres.

In 1938-39, 5 strains, namely, Seraup Kechil 48 and 371, Radin 4 and 13, and Chubai (a Kedah padi stated to be salt resistant), were tested with inconclusive results.

In the 1939-40 season planting was late and although growth of the crop was promising until late December, drought and too early withdrawal of water resulted in a poor harvest.

The following strains were tested:—Seraup Kechil 48 and 371; Mayang Sa' Batil 5, 6 and 8. Of these, Seraup Kechil strains yielded the best, but owing to the unsatisfactory season, yields were not so good as expected.

KUALA KURAU. Work at this Station commenced in 1932, in an area of deep land typical of most of the *mukim*, in the Krian Irrigation Area. It is $4\frac{3}{4}$ acres in extent with a good water supply but liable to flooding.

Experiments over a series of years have shown that long-term strains do better than short-term. Of the former, Seraups, Mayang Kuning 48 and Machang 42 yielded well, although the latter was later discarded owing to susceptibility to rat damage. More recently Mayang Sa'Batil 8 has been tried and found to do well.

In the 1939-40 season planting was carried out according to programme and conditions were good throughout the season. Seraup Kechil 48 and 371 and Mayang Sa'Batil 8 were again tested and yields from Latin Squares in quadruple plots for the past six seasons are as follows.

Strain.	Yields in lbs. per acre.							Percentage of S.K. 48
	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	Average	
S.K. 48 ...	3400	3580	2440	2040	1420	2830	2618	100
S.K. 371 ...	2960	4000	3740	2950	1430	3620	3117	119
M.S.B. 8* ...	—	—	—	—	2180	3700	2940	138

* Based on 2 years' results only.

Mayang Sa'Batil 5, 6 and 8 were also tested against one another but, as at Titi Serong, there was little difference between them.

BRIAH. This Station was occupied in 1932, and is typical of the higher third-class lands in the southern part of the Krian Irrigation area. It is 5 acres in extent and generally receives adequate water supply, while drainage is good.

Early work at this Station showed that Siam 29 was capable of giving good yields, but when field trials were undertaken its straw proved too weak for local conditions. Subsequently Seraups were tested as the demand was for long-term padi and results have been fairly satisfactory.

In the 1939-40 season conditions were good throughout the whole growing period. The same strains were tried as at Kuala Kurau. The results of the first series of Latin Square trials are recorded below.

Strain.	Yields in lbs. per acre.						Percentage of S.K. 48
	1935-36	1936-37	1937-38	1938-39	1939-40	Average	
S.K. 48 ...	1630	2080	1420	1570	1960	1732	100
S.K. 371 ...	1810	2120	1370	1680	1990	1794	104
M.S.B. 8* ...	—	—	—	2120	2340	2230	126

* Based on 2 years only.

In the second series of trials, as at Kuala Kurau, there was no significant difference between the three Mayang Sa'Batil strains.

BAGAN SERAI. Work commenced at this Station in 1934. It is situated in an area of land with a high organic content, approaching the peaty types of soil which occur in patches in the Krian Irrigation Area. It is 5 acres in area and irrigation is satisfactory.

Seraups and Radins have been tested at this Station with mediocre results, and although Mayang Sa'Batil selections have given fair crops the new Serendah selections are intended for land of this nature.

In the 1939-40 season planting was carried out according to programme and conditions were ideal up to the middle of December. The crop harvested, however, was poor owing to too early water withdrawal, accentuated by drought.

Seraup Kechil 48 and 371 and Mayang Sa'Batil 8 were tested, as at Briah and Kuala Kurau. The following table records the results obtained.

Strain.	Yields in lbs. per acre.							Percentage of S.K. 48
	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	Average	
S.K. 48 ...	2630	1980	1550	1640	1850	1510	1860	100
S.K. 371 ...	2770	1970	1640	1820	1940	1420	1927	104
M.S.B. 8* ...	—	—	—	—	2280	1470	1875	112

* Based on 2 years' results only.

Seraup Kechil 48 did better than Seraup Kechil 371 in the 1939-40 season as is often the case when conditions are unfavourable. Mayang Sa'Batil 8, a longer-term padi, naturally felt the effect of early drainage more than Seraup. As at previous Stations there was no significant difference in yields between Mayang Sa'Batil 5, 6 and 8.

Two new selections, namely Serendah 61 and Seri Raja 31, were tested against Seraup Kechil 48. Both yielded well and the results are shown in the following table.

Strain.	Yield in lbs. per acre 1939-40	Percentage of S.K. 48
S.K. 48 ...	1380	100
S.R. 31 ...	1740	126
Ser. 61 ...	1810	131

A total of 82 plants was chosen from a second preliminary selection of local Serendah which will be grown at Titi Serong during the 1940-41 season.

SUNGEI KEPAR. This Station, in the *mukim* of Semanggol in the Krian Irrigation Area, was first leased in 1935. The land is very low-lying, drainage is difficult, and there is frequent flooding. Its area is 2¼ acres and is typical only of small isolated patches in south Krian.

As in the case of Bagan Serai Test Station many strains, mainly Seraup and Radin, have been tried with poor results in most seasons.

In the 1939-40 season water supply was insufficient for short periods early in the season but on the whole fair conditions were experienced and yields were higher than those of the last two years.

Seraups Kechil 48 and 371 and Mayang Sa'Batil 8 were again tested. The results for the past five seasons are shown in the following table.

Strain.	Yield in lbs. per acre.						Percentage of S.K. 48
	1935-36	1936-37	1937-38	1938-39	1939-40	Average	
S.K. 48 ...	1950	1690	750	1240	1640	1454	100
S.K. 371 ...	1920	1420	640	1270	1120	1274	87
M.S.B. 8* ...	—	—	—	1940	1800	1870	130

* Based on 2 years' results only.

Mayang Sa'Batil 8 did well. As at other Stations the three Mayang Sa'Batil strains showed no material differences in yield.

SELINSING. Work commenced in 1932. The Station is on high land towards the south of the Krian Irrigation Area and is typical of many thousands of acres of land. It is 4 acres in area and in common with the surrounding area has in the past often suffered from want of water.

As at Briah Test Station early trials showed the potentialities of Siam 29, which however, failed under field conditions, owing to weakness of straw. Long-term strains are now being tested.

In the 1939-40 season water was insufficient at times and the crop suffered from drought in January. The yield for the Station was slightly below average.

As at the other Stations in Krian, Seraup Kechil 48 and 371 and Mayang Sa' Batil 8 were tested, with the following results:—

Strain.	Yields in lbs. per acre.							Percentage of S.K. 48
	1934-35	1935-36	1936-37	1937-38	1938-39	1939-40	Average	
S.K. 48 ...	1840	1680	1250	1380	1390	1240	1463	100
S.K. 371 ...	1960	1810	1290	1540	1230	1180	1493	102
M.S.B. 8* ...	—	—	—	—	1780	1620	1700	129

* Based on 2 years' results only.

Once again there was little difference between the three strains of Mayang Sa' Batil.

In view of the low yields obtained at this and other Stations in south Krian it is proposed to test the use of cattle for cultivation purposes. The persistent growth of the spike sedge, *Eleocharis ochrostachys*, Steud., is most noticeable in this area and ploughing and other experiments are in hand with the object of suppressing this weed.

Bukit Gantang. This Station was first leased in 1931 and serves Larut and Matang, and Selama Districts. The total area under wet padi in these districts is returned as 12,700 acres. The Station is 3½ acres in extent and situated on the perimeter of the Bukit Gantang Irrigation Area, comprising 2,400 acres of padi fields, which was gazetted as an Irrigation Area in 1940.

In 1932-33 season plots were planted with the following local varieties:— Buyang Melangong, Machang, Serbok Mas, Radin Deli, Tongkat, Pasang, Lumut, Serendah.

Several of these varieties proved promising and preliminary selections were made with Machang, Serbok Mas and Tongkat, which were grown at Titi Serong for trial the following season. Since 1933, Seraup and other long-term strains have been tested, in addition to Radins and Siams, medium or short-term strains, and the long-term strains have usually succeeded slightly better. Some seasons, however, noticeably 1938-39 and 1939-40, favoured the Radin and Siam strains when consistently higher yields of grain were secured.

In the following table, crop records from quadruple plots in Latin Squares are shown over a period of three to five years of the principal strains tested.

Strain.	Yield in lbs. per acre.					Average to nearest 100 lbs.
	1935-36	1936-37	1937-38	1938-39	1939-40	
M.K. 48 ...	—	3810	3943	2540	3760	3500
S.K. 48 ...	2952	3044	3246	2190	2770	2800
S.K. 146 ...	2940	3877	3874	2644	3400	3300
S.B. 15 ...	3108	3060	3410	2787	3450	3200
Sm. 29 ...	1860	3127	1896	3853	3280	2800
Sm. 76 ...	2784	3046	1939	3412	3040	2800
R. 11 ...	2884	2776	2867	3532	3400	3300
R. 13 ...	2544	2827	2764	3092	3090	2900
Mch. 2 ...	—	—	3670	3297	3170	3400
Mch. 5 ...	—	—	3512	3438	3360	3400
Mch. 10 ...	—	—	3594	3181	3270	3300
T. 2 ...	—	—	2976	2911	2910	2900
T. 7 ...	—	—	3150	2378	2970	2800
T. 10 ...	—	—	3036	3044	2900	3000

It is of interest to record the total crop of padi harvested from the entire Station together with the average yield of padi per acre for the past and previous seasons.

Season.	Total Yield of Padi.	Average Yield of Padi per acre.
	gantangs.	gantangs.
1931-32	1253	366
1932-33	1181	345
1933-34	1345	393
1934-35	1228	359
1935-36*	1456	425
1936-37	1628	475
1937-38	1447	422
1938-39	1549	452
1939-40	1732	505

* From 1931 to 1935 irrigation was from a temporary dam, which received annual repairs, and water was often insufficient. The Bukit Berapit dam, erected by the Drainage and Irrigation Department, was brought into use on the 13th August, 1935, and from then onwards a sufficient water supply was available. The annual records show that as a result of improved water supply the crop was raised almost 100 gantangs per acre or 28.5 per cent.

In the 1939-40 season Mayang Sa'Batil strains M.S.B. 5, 6 and 8 were tested for the first time. All gave equally high yields, approximating to 3,800 lbs. padi per acre, which is the maximum yield obtained in Latin Squares at the Station.

Three strains, *i.e.* Machang 2, Mayang Kuning 48, and Tongkat 2, which have averaged approximately 3,000 lbs. padi per acre in Latin Squares for three seasons, were selected for trial in the field in *ketua* plots at Batu Kurau from which area the original seed for selections was obtained. Tongkat 2 is for use in padi fields with deep water.

BRUAS. This Station, 5 acres in area, was first used for trials in 1931. Water supply is from the Bruas River Irrigation system, which was constructed in 1935. It is the testing Station for the Bruas and Parit Sub-districts.

The soil at the Station is patchy and early yields showed irregularity owing to lack of uniformity subsequent upon levelling and stump removal. Since 1935, the increased water supply has resulted in improved conditions.

Seraups and shorter-maturation Siam and Radin strains have been tested in Latin Squares. Seraup Kechil 36, 48, 146 and 371 have given similar yields, whilst S.K. 36 is the strain most in demand by local growers.

Radin strains R. 1, 2, 4, 7, and 13 proved consistently to be poor yielders at this Station and were discontinued.

Siam 29 has been found satisfactory and has given higher yields than Sm. 76.

In the 1939-40 season planting went according to programme and a total yield of 1954 gantangs padi, as against 1648 gantangs for the previous season, was harvested. These crops represent average yields of approximately 390 and 330 gantangs padi per acre, respectively. Mayang Sa'Batil strains M.S.B. 5, 6 and 8 were tested for the first time in Latin Squares, with Seraup Kechil 371 as a standard. All three Mayang Sa'Batil strains yielded equally well, approximating to 3,000 lbs. padi per acre, and were more than 50 per cent. higher than the standard. Investigations regarding the popularity of these Mayang Sa'Batil strains in Bruas District are in hand.

SUNGEI MANIK. The area of the Station is 59 acres. Jungle clearing commenced late in 1934; some 24 acres were cleared for the 1935-36 season when approximately 20 acres were planted. The rest of the Station was cleared later in 1935 and the whole area was planted for the first time in 1936. Since then from 12 to 30 acres have been leased annually to cutivators and the balance of the area used for experiments and seed multiplication. The water supply comes from the Sungei Batang Padang by means of two distributary canals, but mainly by backing up the drain which runs alongside the Teluk Anson-Tapah Road railway line.

The Station is designed to serve the more uniform parts of Sungei Manik Irrigation Area, namely Stages I, IV and perhaps V, amounting to about 20,000 acres. It is on the extreme south of the area and both soil and water control appear to be below average. It was so sited owing to its comparative accessibility. In the deeper areas, the disease known as *penyakit merah* has always given trouble.

The following strains have been or are being tried at the Station:—Seraup Kechil 48, 146 and 371; Siam 29; Radin 4, 7, 11 and 13; Mayang Ebus 88 and 203; Mayang Kuning 48; Mayang Sa'Batil 5, 6 and 8; Seraup Besar 15; and Tongkat 2.

Experimental results in varietal trials have given contradictory results to date but when they are considered in the light of yields from large areas the following facts emerge.

Seraup Kechil 48 is probably the best all-round long-term strain as it stands up well to mediocre conditions. Seraup Kechil 371 is possibly a better strain than Seraup Kechil 48 where conditions are good, but it appears to be more susceptible to *penyakit merah*.

Mayang Sa'Batil has yielded better than Seraup Kechil during the 1939-40 season and has shown promise in the field.

Under certain conditions short-term strains have done very well, of which the best are Siam 29, Radin 4, 11 and 13. Siam 29 yields very heavily in a good season but is more susceptible to damage from rats, deep water and lodging than the Radins.

The other varieties have done well on occasions but, in general, appear to be less suited to Sungei Manik than those already mentioned.

LAMPAM. The area is approximately 6 acres. The land was cleared in 1939. Water supply is from the Sungei Batang Padang. Half the Station was planted with wet padi in 1940.

The Station is representative of the uneven parts of Sungei Manik such as occur in Stages II and III. The soil contains less organic matter and more sand than in Stages I and IV.

No experimental work was undertaken during the 1939-40 season. Dry-land padi was planted late but was badly damaged by pests as adjacent lots were not fully cleared.

Distribution.—The only long-term padi that has been distributed in quantity in Krian District during recent years is Seraup Kechil 48. The quantities of seed padi of this strain distributed during the past five seasons are as follows:—

	gantangs.
1935	3150
1936	5320
1937	7120
1938	5280
1939	3020

Since 1 to 1½ gantangs seed is enough for 1 acre in the more fertile parts of Krian, some 2,000 acres are, therefore, planted with rogued seed each year. The cumulative effect of this annual distribution has become very marked since recipients of seed in past seasons have not only continued cultivation but acted as agents for further distribution.

Prior to this, Siam 29 was distributed in some quantity in Krian South but its issue was discontinued when field trials proved the straw of this strain to be too weak for local conditions. Subsequently, small quantities of Radin, mostly R. 13, were distributed. In the Kuala Kurau Extension Area in the 1939-40 season when clearing operations delayed planting, this strain was in particular demand.

In Larut and Matang District a variety of strains was distributed during the last few years to suit individual requirements of padi planters in these non-commercial areas. These strains have been issued in past seasons and are generally known, although growers show discrimination as to which strain they plant.

The following strains were distributed:—Mayang Kuning 48, Seraup Kechil 48, Seraup Besar 15, Radin 11 and 13, and Siam 29 and 76. Of these, Mayang Kuning 48 was in particular demand both because of its reputation as a high yielder and owing to its palatability.

In Kuala Kangsar District seed was distributed from both Talang Experiment Station and Bruas Test Station. From the former Station seed of Radin 4 and 13, Siam 29 and 76, and lesser quantities of Seraup Kechil 36 and 48 were distributed. Should selections of Radin Che Mah and Chantek Puteh and Merah prove satisfactory under field conditions there is likely to be a considerable demand for these strains, both from Upper Perak and Kuala Kangsar itself.

Seed of Radin selections, mainly Radin 4 and 7, were distributed from Bruas Test Station in 1935, but their popularity declined. During recent years, the two most popular strains have been Seraup Kechil 36 and Siam 29, and seed of both were distributed in fair quantity during the years 1938 and 1939.

Seraup Kechil 48 is the only long-term padi which has been distributed from Sungei Manik Experiment Station to date. This is now by far the most common strain grown in Stage I, and accounted for more than 25 per cent. of padi purchased by the Government Rice Mill, Teluk Anson, from the 1939-40 crop. Since the Government Rice Mill pays a premium of 10 cents per picul for Seraup Kechil 48 in order to encourage production of good milling pure strain padi, and because of the fact that it grows and produces well under local conditions, its popularity is likely to increase.

Radin 4, 11 and 13 and Siam 29 have been distributed in small quantities in Stages II and III and, in larger quantities, in Stage IV. This distribution has been a temporary measure while the land was being opened up; later, Seraup Kechil will be grown in most of Stage IV.

SELANGOR.

Approximately 17,000 acres of Padi.

KUANG. This Station, extending to 5 acres, is situated in the Kuang valley in Ulu Selangor about 1 mile from Kuang Railway Station and is typical of the inland Selangor padi areas.

In the past, harvests have been very variable, mainly on account of the uncertainty of the water supply. A permanent irrigation scheme has now been completed.

Penyakit merah occurs throughout the valley and the Station is no exception, With an ample water supply, however, the degree of attack definitely appears to be on the decline.

The following strains and varieties have been tried on the Station, the list being in descending order of precedence of their appearance in the records commencing in 1930: Seraup 48, Seraup 36, Radin 2, Radin 4, Radin 13, Nachin 27, Puteh Rambai, Radin Siak, F 756, F 824, Nachin 10, Kelantan, F 875, F 741, Acheh, Siam 29, Milek Puteh 9, Radin Siak 17, Radin Siak 34, Banjar Rendah, Che' Minah, Reyong 6, Reyong 20, Radin China 4, Radin 11, Mayang Ebus 88, Mayang Ebus 209, Siam Kampong.

Siam 29 has established itself as by far the best variety at this Station and can usually be depended upon to yield about double that of any other variety including unselected local favourites such as Banjar Rendah and Che' Minah. It is fairly popular with the people in the district and the area cultivated with it is extending. In the variety observation plots in the 1939-40 season Siam 29 yielded on an average from three plots 410 gantangs per acre. The other padis were all roughly of the same order with 200 gantangs per acre.

Panchang Bedena. This Station is centrally situated close to the junction of Parit 4 with the main canal in the Panchang Bedena padi area which comprises the northernmost unit of about 15,000 acres of potentially excellent padi land in the Selangor coastal padi area.

The Station, which was opened for the 1938-39 season, is 14 acres in extent, is well sited and is provided with a permanent store and subordinates' quarters.

The following strains and varieties have been tried here and on its predecessors at Sungei Haji Durani, Parit 1 branch and at Parit 8 which were opened in 1932 and abandoned in favour of the present Station in 1939:—Seraup Kechil 48, Seraup Kechil 146, Seraup Kechil 36, Seraup Besar 15, Radin 2, Radin 4, Radin 11, Radin 13, Mayang Ebus 88, Mayang Ebus 203, Mayang Ebus 209, Reyong 6, Reyong 20, Acheh, Siam 29, Nachin 66, F 824, F 756, Radin China 4, Radin China 17, Bujang, Mayang Susun, Siam 76, Hybrid 1/3. Irrigation has not so far been available at any of these Stations. Nevertheless, in a season such as 1938-39 when rainfall was adequate and evenly distributed during the growing season Mayang Susun, Siam 29, and Mayang Ebus 209 gave yields of as much as 600 gantangs per acre.

With the development of the Selangor coastal area and the advent of irrigation water it is not unlikely that this area will crop well every year. Cultivators themselves maintain that the padi soil at Panchang Bedena is superior to any in the Tanjong Karang area and not inferior to that in Krian. Consequently when irrigation water is available the Panchang Bedena Station will have an important role to fill in investigating the suitability of the heavy-yielding longer maturing padis.

TANJONG KARANG. This Station is in the Sungei Burong section of the Tanjong Karang padi area and is situated not far from Drain No. 2. With the progress of the Irrigation Scheme the area has been resurveyed with the result that the Station has been re-orientated at roughly right angles to its previous axis and reduced in area from 4 acres to the uniform size of one lot of 3 acres.

Negotiations have been started with a view to acquiring two neighbouring lots and so enlarging the Station to 9 acres.

In the past this Station, in the absence of an assured supply of water, has led a precarious existence.

The usual train of events has been as follows. Owing to the late arrival of the rains it was not possible to sow nurseries until well on in September. Heavy rain accompanied by floods then submerged the Station during December. The plants that survived were then subjected to drought and the depredations of rats and insect pests harbouring in neighbouring abandoned lots during January and February.

The last season in which a harvest was successfully secured was in 1935-36. The following strains were planted:—Reyong 20, Radin Siak 34, Radin Siak 17, Acheh, Radin China 12, Siam 29, Radin 2, Mayang Ebus 88, Mayang Ebus 203, Nachin 756. Radin 20 was the most successful. In spite of a small amount of rat damage growth was excellent with an estimated yield of 650 gantangs per acre.

Irrigation will be provided sometime during 1941.

Distribution.—In the Kuala Selangor area large quantities of Siam 29 have been distributed especially at Panchang Bedena where it is a popular padi. Through the failure of crops last season all stocks of padi seed at Panchang Bedena and nearly all at Tanjong Karang have been exhausted. Large stocks of seed of varying degrees of purity from north Malaya have been distributed through the area and consist of the following: Radin China 4, Radin China 17, Reyong 6, Reyong 20, Mayang Ebus 80, Mayang Ebus 88, Mayang Ebus 203, Mashir, Melor, Manik, Siam 29, Siam 76, Radin, Bujang, Anak Didik, Anak Siam, Anak Bernam, Koncho, Pator and Tohkoh.

NEGRI SEMBILAN.

Approximately 35,000 acres of Padi.

AMPANG TINGGI (5½ acres). This Station is situated some 4 miles to the westward of Kuala Pilah town. It is reasonably central to practically the whole of the alienated padi area, although the padi fields, totalling some 18,000 acres, are spread over a wide area.

The principal areas served may be taken as those to the north, west and southwest of Kuala Pilah itself as soil conditions are similar, being of a granite formation. This comprises some 8,500 acres of padi lands. All padi areas to the eastward totalling some 7,000 acres, fall within the quartzite and limestone belts, while some 2,000 odd acres situated in the Johol centre are too far distant to derive much benefit from this Station.

The following strains have over a period of years been tried at this Station:— Radin 2, Radin 11, Radin 13, Nachin 11, Rey 20, Sm 29, F.S. 875, Mk K 3, Radin Siak 7, Radin Siak 17, Radin Siak 18, Radin Siak 34, Mk P 9, Mayang Ebus 203, M.K. 3.

The majority of these strains may be considered unsuitable as they are not popular amongst cultivators, but Sm 29 is a good yielder and popular, Mk K 3 and Rey 20 both exceeded the yield of Sm 29, and may increase in popularity. One of the Radin Siaks, possibly R.S. 34 owing to its shorter maturation period, should be retained.

The season 1939-40 was generally a good one for this Station, An adequate supply of irrigation water was easily maintained, no damage from flooding occurred, and exceptionally fine weather conditions prevailed throughout the harvesting period.

The lowest yield recorded was from the local strain Raja Bersanding with an average yield of 420 gantangs. The local Serendah Kuning, the most popular local strain in the State, and the pure strain Radin 2 both yielded 480 gantangs. All other pure strains exceeded this figure, the highest yield being from Milek Kuning 3 with an average recorded yield of 630 gantangs per acre.

KENDONG (8 acres). The Station is not ideally situated, being tucked away in the extreme southern end of the Rembau padi lands. The soil is of granite formation, as is all that padi land situated roughly to the east of the railway line comprising somewhat less than half the total of 7,700 acres of alienated padi fields. The soil of the balance of the padi area to the westward is mainly of a quartzite formation. The Station is of little if any value to the 2500 acres of padi in the Tampin District as these areas are too scattered and distant.

The following strains have over a period of years been tried at this Station:— Nachin 10, Nachin 11, Nachin 27, Nachin 66, Nachin 756, Seraup Kechil 36, F.S. 875, F.S. 28, Sm 29, Radin 2, Radin 13, R.S. 7, R.S. 17, R.S. 18, R.S. 24, R.S. 34, Seraup K 48, Seraup B 15, Mk K 3, Reyong 6, Reyong 20, M.E. 203.

Those strains considered worth retaining are Sm 29, Mk K 3, and one of the Radin Siaks, possibly 34, for reasons similar to those given for Kuala Pilah. M.P. 9, a good yielder, is not popular, while neither Reyong 6 nor 20 has done well at this Station. The former is hardly worth retaining due to its unpopularity, while there is no object in trying to popularize either of the Reyongs if they cannot beat or equal the yield of Sm 29 which is already popular.

With the exception of Mk K 3 and MP 9, Siam 29 was the only pure strain to yield an excess of 400 gantangs per acre.

The 1939-40 season was generally a poor one, rainfall being considerably below normal, especially for the period June/September.

Ulu Klawang ($5\frac{1}{2}$ acres). The Station is centrally situated serving three quarters of the 4,000 acres of padi land in this district. Soil and that of the area served is of a granite formation. A total area of some 1,000 acres situated in the mukims of Kenaboi and Triang Illir to the northward are too far distant to benefit to any great extent from this Station.

The following strains have over a period of years been tried out either at this Station or at the now abandoned Station at Ulu Triang:—Seraup B 15, Seraup K 36, 48, 146, Milek Kuning 3, May Ebus 80, 202, 203, 209, Radin 2, 4, 11, 13, 16, Siam 29, Nachin 11, 66, Reyong 6, 20, Radin China 4, 17.

As in other parts of the State Sm 29 is quite a good yielder and very popular. Mk K 3 is reasonably good and there exists some demand for seed. Radin China 17 did quite well, but nothing regarding its popularity is known.

The local Serendah Kuning, undoubtedly the most popular padi throughout the State, usually yields well, generally better than the introduced pure strains, and for these two reasons alone it appears obvious that selection of this strain should be undertaken, rather than to introduce and to try to force on to unwilling cultivators, strains from other districts which are little if any better yielders and are not popular.

In both 1939-40 and the previous season Sm 29 gave the best results from squares A and B, but variation between plots was considerable. In square C the local Serendah Kuning gave the highest average yield from anywhere on this Station. Radin China 17 has shown promise of being a good yielder, but nothing is yet known as to the popularity of this strain.

Yields in the 1939-40 season were slightly below those obtained during the previous season principally due to drought conditions.

MALACCA.

Approximately 33,000 acres of Padi.

Pulau Gadong. This Station is situated in a typical coastal padi area on alluvial clay. The area is approximately 80 acres, consisting of an old area opened in 1922 and 50 acres opened up since 1934. This latter area was added to the Station for the special purpose of providing facilities for mechanical cultivation experiments. For this purpose fairly large blocks of dead level land were needed and the considerable amount of levelling required to make the area suitable in this respect has resulted in great irregularity in fertility. Much of the area is at present poor padi soil and difficulties over water supply are another factor which renders the extension area much less suitable for padi experiments than the portion which comprised the original Station. All experimental and selection work is therefore carried out on the old area and multiplication of selected varieties for distribution is done on the new area.

Irrigation comes from the Tanjong Minyak Irrigation Scheme area. In times of good rainfall water is sufficient, but if rainfall is low the supply of irrigation water is inadequate. There are two small irrigation pumps for use in dry weather. A large herd of buffalo is maintained for cultivation.

The Station has been responsible for a large amount of selection work on padi and a very large number of varieties have been selected and tested, not only from Malacca territory but also from Pahang and Negri Sembilan. Many new introductions of the Department have also been tried out at Pulau Gadong including Thailand padi, selections from Borneo, and varieties from India.

Summary of Varieties Selected at Pulau Gadong. (as far as records go).

Season 1929-30. Selections of Siam and Nachin varieties were made this season.

Season 1930-31. Strains of Siam and Nachin first distributed: Siam 29 and Nachin 10. Selection started on 2 varieties (5 strains) from Perak. These were all discarded as showing no promise in Malacca. Selection continued on Siam and Nachin varieties. Selection on 129 Radin Siak strains (Malacca padi) commenced.

Season 1931-32. Selection on 1930-31 varieties continued. Distribution of Nachin 11, Nachin 66 and Siam 76 for the first time. Selection of 19 strains of Milek Puteh and 5 strains of Milek Kuning (*ex* Pahang) commenced.

Season 1932-33. No new selection work. Selection as for 1931-32 continued.

Season 1933-34. Three varieties from China put down for selection. All discarded as no further use. Other selections started previously continued.

Season 1934-35. Selection of 150 strains of Serendah padi commenced (*ex* Malacca). Five proved varieties from British Guiana tested at Pulau Gadong; all discarded as unsuitable: 4 other varieties introduced from Brunei. These were also discarded, showing no promise under local conditions.

Season 1935-36. Selection of Serendah padis continued. Twelve varieties were introduced from India.

Season 1936-37. Padi Nanking introduced by Botanist. Two new varieties received from Pahang, together with 12 strains (new selection) of Milek Puteh. This season selection was commenced on a special Siam strain for strong straw. Indian varieties discarded as unsuitable.

Season 1937-38. Eight varieties received from Negri Sembilan (32 strains). Padi Nanking discarded.

Season 1938-39. Selection commenced on a special Siam padi, from a prize-winning M.A.H.A. sample. Sabit Tamang, a variety from Brunei introduced.

Season 1939-40. A pure strain of Thailand padi introduced for trial and 14 varieties from Negri Sembilan.

Season 1940-41. A further 8 Thailand selections for observation. Preliminary selection commenced again on Nachin and Siam varieties of Malacca.

Of the strains mentioned above the following remain in pure lines at Pulau Gadong:—

Siam 29, 76 *ex* Malacca.
Nachin 11, 66 *ex* Malacca.
Milek Puteh 9 *ex* Pahang.
Serendah 14, 27, 141, 144, 149, *ex* Malacca.
Serendah Puteh 1, 3, 6 *ex* Negri Sembilan.
Serendah Kuning 3, 4, 5 *ex* Negri Sembilan.
Terong Papan 1, 11, 20 *ex* Pahang.
Milek Kuning 3 *ex* Pahang.
Serendah Salleh 3 *ex* Negri Sembilan.
Antah Beras 1, 2, 3 *ex* Negri Sembilan.
Sri Menjadi 5, 9, 12 *ex* Pahang.
Milek Puteh 26, 27, 28, 29 *ex* Pahang.
Radin Siak 17, 24, 25, 34, 69 *ex* Malacca.

All the Negri Sembilan and Pahang varieties have been returned to those States. These selections were fair only at Pulau Gadong and did not come up to our own selections of Siam 29 and Nachin 11. All other numbers except those listed above were discarded as showing no promise.

Summary. 809 strains of padi have been examined at Pulau Gadong Padi Station since 1930. Of these, 35 were pure strains introduced from countries outside Malaya. From the total examined, 36 pure strains have been selected, 14 strains from Malacca and 22 from Negri Sembilan and Pahang. Of the 14 strains from Malacca, 7 are in regular and ever increasing demand, *i.e.* Siam 29, N. 11, Mk. P. 9, Ser. 141, 144, 149 and Radin Siak 34.

Varieties under selection at the present time include the following:—

1st year:—14 varieties from Negri Sembilan, one from Pahang for re-selection, *i.e.*, Padi Sri Ayer, first received in 1936.

2nd year:—Nil.

3rd year:—8 varieties from Negri Sembilan.

Results to date show that of all these padis only Sri Ayer shows any real promise. The Negri Sembilan padis were originally sent to Pulau Gadong as they are popular in certain localities. The Sri Ayer from Pahang is a good padi under swamp conditions.

Malacca varieties:—Nachin (a new selection), Siam (4 new selections). These are in the preliminary selection stage and are being selected on account of high yield and popularity in certain areas. The names Nachin and Siam are kept as although they differ slightly from the recognized Siam 29 and Nachin 11 and 66 the *kampong* names are followed. The numbers, of course, will be a higher series.

The following is a summary of varieties examined at Pulau Gadong and discarded.

Season 1930-31. *Perak Padi.*

F.S. 756
F.S. 824
Radin 2
Radin 7
Radin 11
Radin 13.

Season 1931-32. Nil. *Season 1932-33.* Nil.

Season 1933-34. *Hongkong Padi.*

Kar Serang
Tong San
Oerang Oerangan.

Season 1934-35.

Blue Stick
D. Creole
Ramkajara
No. 75
No. 79
} *ex*: British Guiana.

Langsat
Sabakit
Jangkok
Pulut Marican
} *ex*: Brunei.

Season 1935-36.

Gandar 1 to 14.
Radin Guntor 1 to 6.
C.O. 2, 5, 7, 10.
A.E.B. 178
G.E.B. 24
T. 621
T. 670
Black Puttu
Rascadam
Vankisanam
Sukudas

Season 1936-37.

Nanking Padi 2 lines.

Season 1937-38. Nil. *Season 1938-39.* Nil.

ALOR GAJAH AND JASIN. It is more convenient to deal with these two Stations together than separately because they both serve the same purpose, the one for Alor Gajah and the other for Jasin District.

The varieties grown at each Test Station are the standard ones for Malacca: Siam. 29, Nachin 11, Mk. P. 9, Serendah and Radin Siak 34. The best yielders at Alor Gajah are Siam 29 and Nachin 11; at Jasin, Serendah and Siam 29. Radin Siak as a short-term padi yields very well at both Stations.

Alor Gajah is served by two small tali ayer which in a normal season give a good controlled water supply. The prolonged drought in 1938-39 and 1939-40 was so severe that no crop was reaped from this Station.

Jasin Test Station is situated in the Kesang Tua Irrigation Area and this Station has an excellent controlled water supply.

These two Stations are admirably suited for the purpose of multiplication of varieties and as feeders for Seed Farms. In view of the ever increasing demand for our selected varieties these Stations are now unable to meet the total demand for pure strain seed and Seed Farms have been established in addition.

Distribution.—Siam 29, 76, Mk. P. 9, N. 11, 66, Radin Siak 34, Serendah 141, 144 and 149.

The above are the most successful strains selected at Pulau Gadong and used for local distribution. Of these strains two have gone out entirely: Siam 76 and Nachin 66. Siam 76, on account of lower yield, compared with Siam 29 and with Nachin 66 because it has proved difficult to thresh, although it is a heavy cropper.

The two most popular padis are Siam 29 and Nachin 11. Siam 29 has lost some of its popularity on account of straw weakness but it still has the greatest demand. Mk. P. 9, a Pahang variety, was first distributed in 1937-38 season. It is a heavy yielder especially under deep conditions and has become very popular. It has good straw. Serendah selections were first distributed in the 1937-38 season; straw strength is good and it is suited to certain deep areas in Alor Gajah District and Jasin. Siam 29 and Nachin 11 are the most popular varieties for the coastal areas. Demand for Nachin 11 is increasing.

Radin Siak 34 is a short-term padi and demand for this is increasing annually. It yields well but is a short-season padi. Its popularity is due to the fact that in recent seasons the water supply has been so uncertain that planting cannot be carried out at the normal time (July-August). Radin Siak has proved itself a good yielder for September/October planting. It has a very good straw and is therefore very easy to harvest.

Each of the varieties mentioned above is grown on the Padi Test Stations and distributed from there to Seed Farms and to cultivators.

Total pure strain padi distribution, *i.e.*, from Pulau Gadong, Alor Gajah and Jasin is as follows:—

		gantangs	
1935	...	3,900	
1936	...	4,184	
1937	...	5,233	
1938	...	5,620	Demand greatly in excess of supply. Supply short on account of drought conditions.
1939	...	6,100	
1940	...	4,300	

PAHANG.

Approximately 41,000 acres of Padi.

The above figure is based on the 1939-40 returns but the acreage planted in Pahang is liable to vary from season to season more than in other States or Settlements chiefly because a large proportion of the crop is planted on the "paya" system.

The word *paya* is commonly used in Pahang to denote any area on which wet padi is grown, but it is convenient to reserve the term "paya system of cultivation" for a particular system which though not unknown elsewhere in Malaya, is specially typical of Pahang.

Essential features of the *paya* system which provide distinct contrasts to normal methods of irrigation are: (a) that the *paya* is flooded by damming in the off-season, often to a considerable depth in its lower portions, and (b) that the dams are opened and the water level is gradually lowered as planting proceeds; this operation is commenced on the periphery of the inundated area and is continued towards the lower levels of the *paya* as the water recedes. As with most deviations from normal usage, this distinct departure from standard practice is peculiarly suited to the local conditions. A typical *paya* may be roughly described as a shallow depression with an opening at one end which provides drainage to the Pahang River or one of its tributaries at low water levels, but which also allows ingress of flood water when the river is in spate, a condition which normally obtains to a greater or less degree in January after the heavy rain customary in November and December. Generally there is no possibility of irrigation from streams, the higher land surrounding a *paya* being neither very high nor extensive. The cultivators aim to harvest their crop in November or December before the *paya* is inundated with flood water. Dams are erected in time to retain some of the flood water and to collect any rain which falls before the next planting season commences in about March or April, the dams being opened in May or June to reduce the water level and so allow of planting the lower levels of the *paya*. When planting is completed dams are again closed to keep the water to the level considered most suitable for the crop in a particular season. The area planted each season will depend upon the height to which the *paya* was inundated in the previous off-season and the success of the crop in the various parts of the *paya* will depend upon the rainfall in the growing season. A dry season results in too little water for the crop on the periphery whilst in a

wetter season the crop in the lower levels suffers from too deep water: but in most seasons a reasonably good yield is obtained from one or other portion of the *paya*. Pahang is sparsely populated, so land is plentiful and in such circumstances the *paya* system provides an easy method of cultivating padi with certainty of a very fair return in most seasons fully commensurate to the labour involved.

With a denser population and consequent greater demand for land present cultivation methods and especially the *paya* system would not be satisfactory, and investigations and experiments have been directed in recent years towards ascertaining a manner in which more economical use can be made of the land available for padi. The main points involved are a determination of the optimum planting season under any other system which may be tried and how best to conserve water on the land.

In the past many comparative yield trials have been conducted on Test Stations and a fair amount of seed of pure strains has been distributed in small parcels to individual cultivators. Though some of these strains have given good yields on Test Stations in Pahang, they have generally not proved suitable for areas where the *paya* system is practised.

The matter of a selection Station for Pahang has been raised from time to time but it has been decided to leave this in abeyance for the present and to concentrate on the more important cultivation problems peculiar to Pahang. For these reasons the following account deals mainly with experiments concerning Pahang's special problems; only brief mention is made of comparative yield trials and no complete record of past results of such trials is attempted.

Dong. The Dong Station is situated in one of the most fertile valleys found along the Raub-Lipis Road and is sited in the irrigated Dong area. Not all the padi areas enjoy irrigation facilities but the Station is typical of such as do and results obtained can be put into effect in the area the Station is intended to serve.

In the 1939-40 season most of the Station was given over to a replicated dates-of-sowing experiment employing three varieties with six dates of sowing commencing with nurseries on June 4th and thereafter at fortnightly intervals. The experiment arose out of a similar but less precise exploratory trial in the 1938-39 season from which trial it appeared that the early-sown crop yielded better than that sown later. The vegetative growth in the 1939-40 season in the case of the two early-sown dates was excellent but, for reasons which are not clear, the ears set badly and the yield was low. The yields from the remaining four dates were good but uniform and it was decided to repeat the experiment *in toto* in the current season.

A feature of the experiment was the high over-all average yield of the three varieties, viz.:

	gantangs per acre.
Milek Kuning 3	563
Siam 29	467
Radin China	412

LIPIS. Lipis Station is neither suitably sited nor typical of Lipis District. It is situated at the lower end of a quite unimportant small valley near Penjom and there is no other padi land of any extent in the immediate locality. The main padi areas of Lipis, mainly dependent on rainfall, are some 20 miles away along the Benta-Jerantut Road. It is proposed, if possible, to transfer the Station to a site in Budu or Tanjong Besar in 1941.

In the 1939-40 season the dates-of-sowing experiment mentioned under Dong was duplicated at Lipis. A fair crop calculated at 326 and 320 gantangs per acre was obtained from plots planted from nurseries sown on 4th and 20th June, 1939, respectively. A smaller crop was obtained from 4th July plots, practically nothing from 20th July nurseries and, owing to flooding, no crop at all in the case of 4th and 20th August sowings. Considered together with the results obtained from the preliminary trial in the previous season (1938-39), the conclusion at Lipis is clear. It is not so much that early plantings under conditions obtaining at the Station give better yields than if planting is delayed as that the flooding to which this Station is prone late in the year precludes any crop at all being obtained. Consequently in the current season the August sowings have been deleted and May sowings introduced, the difficulty in this connexion being that as irrigation facilities are not available there may be insufficient rainfall to permit sowings so early as May to be established.

PULAU TAWAR. The Station is typical of the area of the same name in which it is situated. The problem here is not so much what variety to grow as to how to raise a crop at all. The *paya* is one in which the levels were considerably altered by deposition of sediments from the 1926 flood. An irrigation project from the Sungei Salan was completed in 1926, but before much benefit could be derived from it, the flood wiped out the scheme and it has not, apparently, been possible to resurrect it. The *paya* is now managed in the typical manner described earlier. A complication is that the lowest layer of the flood-deposited material is very coarse in texture and appears to function as a subsoil drain. Formerly, the plantable area was in the neighbourhood of 1,000 acres but experience for two seasons showed that it was impossible to grow a crop above the 97 ft. contour level and the present fenced-off area of some 300 to 350 acres now follows approximately that contour. However, even at 97 ft. contour, a protracted mid-year dry period resulted in Milek Kuning 3 giving only a few gantangs and Siam 29 nothing at all in the 1938-39 season. Conditions in 1939-40 season were much the best to date. The *paya* filled up well during the short wet season; water was knee deep at the 97 ft. contour just prior to transplanting; the mid-year dry period was neither lengthy nor intense; and the wet season commenced during September. The yields obtained were (in gantangs per acre):—Gangsar Tembeling 372, Milek Kuning 3, 336, Serendah 300, and Siam 29, 278. Bunds were thrown up and the *petak** ploughed and harrowed wet in the Kelantan fashion as the water receded. Time, however, was limited as the fall in water level once the dam is opened is rather rapid and in the current

* *petak* = the small square divisions of a large padi area.

season the proposal was to do the puddling during the period the *paya* filled up since the rise of the water level is not usually rapid and there is ample time to carry out the operation properly. However, 1940 has been extraordinarily dry at Pulau Tawar and, up to mid-October, the *paya* has never had free water available, not even at the lower contour levels and it is regretted that no action at all has been possible at Pulau Tawar this season.

KERDAU. Kerdau Station was opened in 1936 in order to provide better facilities for comparative yield trials under the *paya* system of cultivation than those furnished by a former Station in the same locality. The Station is situated in the upper portion (farthest removed from the outlet to the river) of a typical large *paya*, Paya Tarum.

In the 1939-40 season most of the Station was employed for comparative yield trials with the four pure strains Milek Kuning 3, Siam 29, Reyong 20, Radin 13 and with three popular unselected local varieties, Seri Ayer, Seri Bumi and Gangsar Tembeling. It has been found that the Latin Square technique is ill-adapted to *paya* conditions and the most suitable method appears to be that of randomized strips, only sufficiently wide to allow 11 ft. x 11 ft. or 11 ft. x 33 ft. sub-plots to be demarcated from which to estimate yields, running across the full width of the *paya* in order to take cognisance of the variation in water levels. At least half-a-dozen replicates are desirable.

Raft nurseries were possible in the season under review and the period in the nurseries was standardized at 50 days for all varieties which were all sown on the one day. The season was, on the whole, a good one, the distribution of the rainfall being better than may normally be expected in the riverine *paya* areas. Yields as calculated from 11 ft. x 33 ft. sub-plots were good, viz:—

	gantangs per acre.	Maturation Period. days.
Reyong 20	... 466	... 222
Seri Ayer	... 465	... 221
M. Kuning 3	419 (479)	... 239
Tembeling	... 371	... 209
Seri Bumi	... 363	... 210
Siam 29	... 353	... 225
Radin 13	... 321	... 235

(One plot of Milek Kuning 3 was eaten by buffalo and the figure in brackets gives the yield excluding the damaged plot).

It was known that the maturation periods of West Coast introductions lengthen when grown in Pahang but attempts previously to regulate the date-of-sowing nurseries in order to arrange that the harvest for all strains sown would occur at much the same period resulted in much confusion and it was difficult to determine exactly what is the maturation period for a given strain at a certain Pahang Station. Further, the length of time seedlings were in the nurseries often varied considerably (not

always the fault of the person in charge). It was considered that the simplest method of approach to the question of the maturation period would be to sow all varieties on the one day, standardize the nursery period and note the results—which are tabulated above. It will be seen that the maturation period for both Reyong 20 and Siam 29 is over 7 months and for Radin 13 is nearly 8 months under Kerdau conditions.

An attempt to plant a small portion of high land for a September/February season failed from lack of water.

In the current season, Siam 29 and Radin 13 have been discarded and the local variety, Serendah, included (total of 6 varieties).

MENGKARAK. This Station is situated on one side of a typical *paya* and the *paya* system of cultivation is practised in this and all other surrounding padi areas. In the 1939-40 season the pure strains , Milek Kuning 3, Reyong 20, Siam 29 and Radin 13, and the two local varieties, Gangsar Tembeling and Serendah Kuning, were planted, employing the randomized strip technique described under Kerdau. Both raft nurseries followed by a single transplanting and dry nurseries were used, all strains planted on the same day and transplanted after 50 days in the nursery. The seedlings from the dry nurseries were undoubtably the better.

There was sufficient water available during transplanting in mid-July but insufficient thereafter until October. Yields were only fair:—

		gantangs per acre.		Maturation Period. days.
Milek Kuning 3	...	300	...	245
Reyong 20	...	247	...	218
Tembeling	...	230	...	196
Serendah	...	197	...	218
Radin 13	...	197	...	251
Siam 29	...	190	...	236

The results are much the same as those noted at Kerdau; Milek Kuning 3 and Reyong 20 have done well, the local strains occupy an intermediate position, and Radin 13 and Siam 29 are the poorest of the West Coast introductions. Note, also, the maturation periods of the West Coast strains; the seed used is material which is well acclimatized to *paya* conditions and, as at Kerdau, the maturation periods are definitely longer than they would normally be at West Coast Padi Stations. A block transplanted during October with the object of a February/March harvest came to nothing; too deep water prevented the crop establishing. Such trials cannot easily be carried out at small *paya* Stations and one needs control of a whole *paya* as at Chenor to which Station experiments of this nature will be confined.

For the current season, Radin 13 and Siam 29 have been deleted and Seri Ayer, Seri Bumi and Ekor Kerbau included.

CHENOR. This Station was opened with the principal object of investigating how cultivation methods can be modified on areas where the *paya* system at present obtains, in order to utilize the land to the best advantage. Investigations into the effect of puddling the land on the lines employed in Kelantan are an integral part of the experiments.

In the 1938-39 season an attempt was made to grow a crop following the West Coast season (allowing for a February harvest) which, on theoretical grounds, seems to be a more logical one than the usual one under the *paya* system with harvest in the wet month of December. A crop was successfully raised, but it does not necessarily follow that this would happen in the majority of seasons, the governing factor being the frequency with which annual flooding would be sufficiently severe to damage considerably a standing crop. This obviously varies with different *paya*, depending upon their height above mean sea level, and is a matter that is receiving further investigation.

In the meantime it has been decided to ascertain if the Kelantan puddling technique can be used advantageously in combination with the usual *paya* system season.

As the result of unusually dry weather it was not found possible to inundate the Chenor and many other *paya* during the last off-season so the puddling operations have had to be postponed, and work done was confined to making suitable bunds to facilitate operations in the 1941 season.

PAYA BESAR. This Station is situated on a *paya* of the same name of some 3,000 acres in extent. The *paya* system is not practised here and there are facilities for irrigating the area in the orthodox manner. The soil on the Station is composed of flood deposits and consists of alternate layers of peat and a greyish-white clay. As far as is known this peculiar soil is typical of the whole Paya Besar area. Yields have been consistently poor and the main object of the Station is to seek some practical way of improving them.

The following is a brief record of the work done during the past season.

The long-range experiment with tillage at different depths laid down in the 1934-5 season was continued. Results to date indicate little difference between light surface and 9 ins. deep tillage, but tillage to 18 ins. has resulted up to the present in decreased yield.

The methods-of-cultivation experiment was redesigned as a large-scale 4-way Latin Square comprising *tajak*,† ploughed once, ploughed twice, and *melanyak*.* The results were:—

	gantangs per acre.
Tajak	279
Ploughed once	277
Ploughed twice	366
Melanyak	328

* *melanyak* = trampling by buffaloes.

† *tajak* = scything weed growth.

The experiment is essentially a long-term one and the figures for one season only are not of special significance. A pleasing feature was the evenness of the stand (Siam 29) over the whole area and the average yield of 320 gantangs per acre.

It is possible that the accumulation in the standing water of organic acids from the peat may result in conditions unsuitable for padi. Two obvious remedies would be (a) liming and (b) frequent changes of water in order to keep the water in the fields as fresh as possible. Relative to (a), a standard 4-way liming trial using 10 tons, 5 tons, 1 ton per acre and no lime (variety Milek Kuning 3) was carried out. The results were:—

	gantangs per acre.
Lime at the rate of 10 tons per acre ...	396
,, ,, ,, ,, ,, 5 ,, ,, ,, ...	369
,, ,, ,, ,, ,, 1 ,, ,, ,, ...	320
No lime	287

It seems evident that some benefit has accrued from the use of lime. The trial is being repeated on the same site in the current season when the next step would appear to be to experiment with more economic quantities of lime.

An exploratory dates-of-sowing trial was considered sufficiently satisfactory to warrant laying down a more critical experiment in the following season on the lines of that conducted at Dong Station.

Investigations into the reason for the disappearance from the Station of a particular weed (probably *Scleria sumatraensis*) from the fallow growth, though the species still persists in much of the surrounding area, rather suggests that the more regular weeding practised on the Station may be responsible. The experiment is being repeated in the coming season as further data are required.

Pahang Tua. This Station is suitably situated in the Pahang Tua padi area which is not a *paya* in the restricted meaning of the term, being well adapted for the orthodox method of irrigation.

Prior to the 1926 flood, when the level was raised by flood deposits, it produced good crops of padi. Though the difference in level created irrigation problems the deposits were in the main fine-grained and analyses indicate that the soil over the majority of the area is suitable for padi cultivation, though there are a few peaty and some sandy spots. A pumping plant has been installed recently which should solve the irrigation difficulty satisfactorily. It is possible that some of the high-yielding strains of West Coast varieties may prove to be more suitable to this area than those under the *paya* system of cultivation.

In the 1939-40 season the principal experiment was an exploratory trial of dates-of-sowing commencing with nurseries sown on 4th July, 1939, and continuing at approximately fortnightly intervals until 20th September, 1939. Siam 29, Reyong 20, Milek Kuning 3 and *kampong* Milek Kuning were used. The yields

from the earlier-sown plots were heavy but fell off considerably for the September sowings. On the latter plots, however, rat damage occurred as the neighbouring *kampong* folk planted contemporaneously with the earlier-sown blocks. In summary the results were:—

1939.				gantangs per acre.
Sown on 4th July	...	...	...	774
,, 20th July	...	...	...	684
,, 4th August	...	...	...	582
,, 20th August	...	...	...	565
,, 4th September	...	...	...	311
,, 20th September	...	...	...	235

A more precise experiment has been laid down in the current season.

The remainder of the Station was planted with replicated strips of nine varieties. Transplanting was, for unavoidable reaons, late and yields were low:—Milek Puteh 148 with 338 gantangs per acre, Radin China 4, 227 gantangs per acre and *kampong* Milek Kuning 226 gantangs per acre leading. Strip planting of varieties and a preliminary examination of Milek material with a view to possible selection is also being undertaken in the present season.

BAWANG. This Station is an isolated piece of true irrigated *sawah* whereas all the padi areas in the region are typical *paya*. It has been suggested that since the Station is atypical of the area it is expected to serve it should be discontinued. On the other hand the water supply is good and obtainable as and when required which makes it an excellent place at which to conduct dates-of-sowing work which must of course be carried out strictly to schedule.

Bawang also affords an opportunity of finding out why better yields are not obtainable, even with an assured water supply. There is peat present and stem borers may be unusually severe (the 1938 crop was riddled by borers) and the plot is subject to flooding late in the year. An experiment with different methods of cultivation gave no significant results but applications of rock phosphate and an N.P.K. mixture produced a significant increase in yield. For the present, however, attention is being directed on the optimum time to sow.

In the 1939-40 season the major portion of the Station was occupied by a dates-of-sowing trial using the varieties Milek Kuning 3, Siam 29, Mayang Ebus 80 and Seri Bumi and a series of sowings commencing 4th June, and continuing at fortnightly intervals until 20th August, 1939. The result obtained was:—

1939.				gantangs per acre.
Sown on 4th June	...	...	...	424
,, 20th June	...	...	...	330
,, 4th July	...	...	...	246
,, 20th July	...	...	...	170
,, 4th August	...	...	...	154
,, 20th August	...	...	...	135

It should be remembered that the trial was an exploratory, unreplicated one but there seems little doubt that at this Station early planting is preferable. The later sowings gave a February/March harvest and the growing season extended over the theoretically more logical West Coast season. The earlier sown block (4th June) was reaped in late December/early January, slightly later than the *kampong* people along the Pahang River normally expect to reap. In the current season, May sowings have been included and the August dates discarded. This approaches very near to the local *kampong* dates for laying down nurseries. The current season's experiment is properly replicated. Stem borers have sometimes been exceptionally severe at Bawang and opportunity is being taken to observe under field conditions and natural infestation the relationship of time of sowing to degree of borer attack.

The lower portion of the Station was strip planted using six West Coast strains, one Pahang pure strain (Milek Kuning 3) and the two most popular local varieties, Anak Terus and Seri Bumi. The soil in this part is rather peaty and yields were low despite April/May nurseries. Anak Terus headed the list with 237 gantangs per acre followed by Nachin 66, 223 gantangs, Siam 29, 220 gantangs and Reyong 20, Seri Bumi and Radin China 4 all around 190 gantangs per acre. Milek Kuning 3, which generally does well at Pahang Stations, performed poorly. However, the Milek group dominates from this *mukim* (Luit) to the coast and the other varieties have been temporarily dropped and an examination of collections of Milek material from a wide area is being conducted.

KELANTAN.

Approximately 128,000 acres of Wet Padi and 36,000 acres of Dry Padi.

The dry padi acreage is included for this State because the production of dry land padi in Kelantan is an established industry based on sound principles of farming, whereas most of the dry padi in other parts of Malaya is produced under the more primitive form of agriculture known as shifting cultivation. In Kelantan the methods of cultivation practised both for wet and dry padi are of a comparatively high standard. More detailed information regarding the industry in this as as well as other parts of Malaya will be found in an article in the February 1939 number of this Journal.

KOTA BHARU (22½ acres). *Selections.*—(i) Wet Padi. Selection work on local varieties was commenced at the Kota Bharu Experiment Station in 1933-34, but in 1937 in order to concentrate upon the more popular and generally grown varieties, the following were dropped:—Bintang Berayong, Pulut Kunyit, Chemara, Jarum Mas, Jambu, and Jambu Telor. The remainder are still under selection and comprise:—(a) Medium-term varieties:—Anak Naga, Singgora. (b) Long-term varieties:—Padang Trengganu, Morak Sepilai, Mayang Segumpal, Nalong, Manek Siam.

Anak Naga is a variety very widely grown in Kelantan on the medium lands, with an attractive long grain of good milling quality, and a fairly strong straw. It is usually a prize winner at the District Agricultural Shows. Selection has been narrowed down now to 6 strains, four of which were put down for trial against the unselected variety in 1939-40. Owing to an error after the 1938-39 harvest, it was found in 1939-40 that two of these strains were badly mixed in both the lines and the Latin Square, and are now probably lost. The remaining 4 lines will be tested in the 1940-41 season.

Singgora is believed to be a padi introduced from Siam after the 1926 flood, but is not planted to any appreciable extent. It has a curved Siam type grain and a strong straw. Only 4 lines of this variety are retained and, as in the case of Anak Naga, mixing occurred in one line in 1938-39. No significant differences were found in the Latin Square trial in 1939-40, and it is very doubtful whether any good will come of selection among this variety. It is possible that the original introduction was on quite a small scale, and was at the start nearly a pure strain. The potential yield does not appear to be high.

Padang Trengganu is a long-term padi with a maturation period of about 220 days, widely grown in places where water supplies are ample (the lower-lying heavier clays), though it does well also on the lighter clays of Pasir Puteh District. Four strains have been selected, of which P.T. 22 has been proved the higher yielder at Kota Bharu, and the results at Pasir Puteh confirm this.

Confirmation of the Morak Sepilai trials in 1938-39 was obtained in 1939-40, Mor. S. 22 and 26 being very significantly higher-yielding than the other two strains. Of these, Mor. S. 22 will be multiplied in 1940-41 for extended field trials.

Mayang Segumpal is perhaps the most commonly grown long-term Kelantan padi, and M.S.G. 16 is probably the highest-yielding strain of this variety. The Latin Square trial in 1939-40 was damaged by rats, so that no fair comparison could be made with M.S.G. 14.

Eight strains of Nalong were discarded, leaving eight for retention, of which four will be tested against the unselected variety in 1941.

The Manek Siam strains have been reduced to 10 for another season's examination in the lines.

(ii) Dry Padi. A small part of Kota Bharu Experiment Station was planted annually with dry padi from 1932 to 1940, varietal trials and selection work both being started in the same year. Varieties planted were Muar Pa'Dok, Padang Serai, Sa Bumi Puteh, Jintan Koring, Kaki Merpati, Muar Pandan, Anak Lebah, Jintan Manis, Kedah and Neriun. Of these, Muar Pandan, Kedah and Neriun were soon dropped on account of their short maturation periods, and the remainder appeared in varietal trials until the 1937-38 season. Owing to the proximity of the Experiment Station to the town and the fact that the padi was usually the earliest ripening in the locality, birds did a great deal of damage, and no really reliable series of results was obtained.

Notwithstanding these difficulties attempts were made to do selection work on 5 varieties, viz. Muar Pa'Dok, Padang Serai, Sa Bumi Puteh, Jintan Koring, and Kaki Merpati, and 4 strains of each had been selected by the start of the 1939-40 season.

Notes on Imported Strains.—When the Kota Bharu Experiment Station was first opened, trials of local varieties were carried out at Pasir Puteh Padi Test Station, and the Kota Bharu Experiment Station used for the strains imported from the Straits Settlements and Federated Malay States with the intention of later being able to compare the best of the local selections with the best of the imported strains.

The following is a complete list of all the imported varieties which have been grown at Kota Bharu Experiment Station:—

Short-Term.	Medium-Term.		Long-Term.
R.S. 7	Acheh (unselected)	Sm. 76	S.B. 15
R.S. 17	R. 2	Sm. 29	S.K. 36
R.S. 18	R. 4	N. 27	S.K. 48
R.S. 24	R. 13	Rey. 6	S.K. 146
	F.S. 27	Rey. 20	S.K. 371
	N. 66	M.E. 88	M.K. 48
	M.E. 203	R.C. 4	

Of the short-term strains there was little to choose, and R.S. 24 is retained for use as a late short-term padi on Kota Bharu Experiment Station, where it is quite satisfactory.

Of the medium-term strains, the last six in the list only are retained. Sm. 29 was the best of them all for a number of years, but a later introduction, M.E. 88, gave a significantly higher yield in 1939-40.

Among the long-term strains Seraup 36 was consistently the best until 1939-40 when it was run very close by the newly introduced M.K. 48. Of these, only Seraup 15 has been dropped.

At present, therefore, Sm. 29 is the standard imported medium-term padi and Seraup 36 the standard imported long-term, but it is possible that either of these may be displaced within the next few years on the grounds of yield by the other imported strains mentioned, or by selections from local varieties which will be tested against them very shortly.

In the 1939-40 seasons six Latin Square varietal trials were conducted consisting of four squares devoted to comparative tests of strains selected from local varieties, and two squares of strains selected in other parts of Malaya.

The two squares of imported strains were repeat experiments from 1938-39 when no significant differences were obtained, and comprised 6 months strains in the one case, and 7 months strains in the other. The important finding among the 6 months strains was that M.E. 88 was significantly higher-yielding than Sm. 29, which, over a period of 5 years, had been the best imported medium-term strain. The others in this square were Reyong 6 and 20, and Radin China 4, among which there was no significant difference.

The 7 months imported strains were Seraups 15, 36, 146, 371 and Mayang Kuning 48. Over a period of years Seraup 36 had been a very satisfactory yielder, but during the current year the higher yield of Mayang Kuning 48 only just failed to reach significance.

PASIR MAS. This Station has an area of 8½ acres, of which about 6 acres are padi land. It is situated a short distance from Pasir Mas town on the rather high, unirrigated medium-clay land, and is typical of a large area to the west of the Kelantan river. Water supplies being dependent upon rainfall means that only the lowest-lying land in the district can be planted with a long-term wet padi, and such land is not very extensive. As the land gets higher, so has the maturation period of the padi to be reduced and the planting date made later, until on the highest land, which has water lying on it for only a relatively short period during the season, a late sown short-term padi such as Anak Ikan with a maturation period of about 166 days is used. The Pasir Mas Station serves this rather high ground, and in 1938-39 it was found that the medium to long-term imported strains showed less promise than the medium to short-term local varieties.

The experimental work undertaken in 1939-40 and to be continued for the next 1 or 2 years, was block planting of two medium and one short-term padi, with three dates of transplanting for each, *i.e.* mid-October, mid-November, and mid-December. The varieties concerned were Siam 29, Anak Naga unselected and Anak Ikan unselected, and as no statistical lay-out was adopted, the results obtained have to be accepted with reserve. There is moreover the effect on the crop of the incidence of the monsoon rains, which during the season were late in starting, and at no time very heavy, so that the land had water lying on it for only about 2½ months. In spite of this both the medium-term varieties yielded better than Anak Ikan for the earliest transplanting, and Siam 29 and Anak Ikan were more tolerant of late planting than was Anak Naga. All, however, gave their highest yield when transplanted in mid-October, later planting inducing a progressively lower yield. Siam 29 was all round the most satisfactory, the yields ranging from 100 to 300 gantangs per acre.

Slightly modified, this experiment is being continued in the 1940-41 season.

PASIR PUTEH. This is the smallest Station in Kelantan and serves the sandy clays of the south-east coastal area, but its convenient site and the regularity of water supply is to some extent offset by liability to rat damage in the varietal trials.

The experimental work since the Station was started in 1932-33 has been devoted to trials of local varieties and imported strains and manurial experiments.

The following unselected varieties have been tried:—

Long-Term:—Padang Trengganu, Manek Siam, Nalong, Rambutan, Pahit, Chatek, Serendah, Anak Ulat. The first three of these are the best, and a further improvement can be looked for with the use of pure strains now under selection at Kota Bharu Experiment Station.

Medium-Term:—Anak Naga only has been grown, and it did fairly well for the three seasons in which it was grown.

Short-Term:—Anak Ikan Tinggi and Anak Ikan Sombong were neither of any value.

The following are the imported strains tried:—

Long-Term:—Mayang Kuning 48, Seraup 371, Mayang Sabatil 8. Of these Mayang Kuning 48 is distinctly promising, and in 1939-40 was fully up to the yield of the local selection Padang Trengganu 22.

Medium-Term:—Siam 29, Reyong 6, Radin China 4, Mayang Ebos 80, Siam 76, Nachin 66, Radin 2, 4, 13, F. 824, F. 27. Siam 29 is the highest-yielding of these, but cannot of course compete with the long-term padis in the matter of yielding on the lower-lying land.

Experiments in 1939-40 were repetitions of those done in 1938-39. From them, confirmation was obtained of the high yield of P.T. 22, as compared with the other Padang Trengganu selections, while Mayang Kuning 48 was shown to be capable of similar yields.

Bachok. This Station was devoted to manurial experiments only during the 1939-40 season.

Melor. Establishment of this Station has now been completed, and in the forthcoming season will be used for trials of dry padi selections originating from Kota Bharu Experiment Station.

Distribution of Pure Strains.—The only strains that have been distributed in Kelantan have been Siam 29 and Seraup 36, and to a very small extent, Chubai 18 for trial planting in coastal land subject to the influx of sea water.

Siam 29 has been a useful padi for the medium irrigated lands, whether they be sandy or clayey, and distributions were increased considerably in 1939-40 by the laying down of small-holding plots in each District of the State. The results of cutting tests were very variable, and on the whole made no more than a fair showing. It gave very fair promise in Pasir Mas and Pasir Puteh Districts, but was less satisfactory in the others. Instances have arisen of padi planters being under the impression at planting that Siam 29 was Anak Naga, and were disappointed when a rather delayed harvest resulted in extensive lodging. Siam 29 is unlikely to survive if a good pure strain is selected from Anak Naga.

Seraup 36 in the hands of small-holders put up a good showing, though the low rainfall was probably responsible for a reduced yield in a number of cases, to which it seems to be more sensitive than Mayang Segumpal and Padang Trengganu.

Chubai 18 has been distributed in small quantities from year to year in response to requests from padi planters for a strain likely to stand up to the brackish water that is liable to enter some of the coastal padi fields. It has not survived in the localities where it was distributed in the delta of the Kelantan river, padi planters saying that it was extremely susceptible to rat damage, and that it yielded less well than the local varieties such as Mayang Segumpal, Kemaman, and Che Ali. Similar evidence of its inferiority has been obtained from the south-east of the State, where Padang Trengganu, Singgora, and Chatek are considered more suitable.

JOHORE.

Approximately 14,700 acres of Padi.

Of recent years more interest than formerly has been taken in the local production of padi in this State and large areas of land are being explored to ascertain their suitability for the crop in respect of both soil and irrigation.

Prior to 1935 there was no padi Station in the State but during that year two were opened in the Northern Circle and one in the Central Circle. In comparative yield trials on these Stations higher yields have been obtained from several of the pure strains than from local varieties, but some of these strains are inferior to local varieties in respect of strength of straw, and for this reason are not suitable for general cultivation in some localities. With a view to meeting the requirements of such localities selection has commenced on the more promising of the local varieties.

TANGKAK. This Station is situated within the Tangkak Town Board Limits and is $4\frac{3}{4}$ acres in area. The soil is a fairly heavy alluvial clay and ideal for padi cultivation. A permanent irrigation scheme ensures an adequate water supply under normal weather conditions.

The Station was primarily intended to serve the needs of all areas around Tangkak, but with the resumption of cultivation of abandoned padi lands over wide areas in the Muar District, the importance of the Station has been considerably increased.

Two local varieties of padi popular among cultivators around Tangkak District and combining fair yield and straw strength are Daron and Nachin Puteh. During the season 1939-40 it was decided to commence selection work with these two varieties. Owing, however, to the limitation of space due to the demands made by the standard trials, it was possible to put down only 45 lines of each variety.

Nachin Puteh showed up badly under trial but Daron was promising. Of the original 45 lines, 23 were discarded on field characters and yield, the remaining 22 being retained for further investigation. The maturation period of the lines averaged 196 days.

In addition to the selection work recently commenced at this Station, varietal trials have been carried out since season 1936-37, and observations made on the behaviour of improved strains of padi under local conditions.

In the comparative yield trials conducted to date at this Station Siam 29 has consistently given higher yields than any others tried and Radin China 17, Reyong 6 and Reyong 20 (Telok Changai selection) have shown distinct promise.

JEMENTAH. This Station is situated near Jementah village, approximately 13 miles from Segamat, on the Segamat-Muar Road, and is 6 acres in area. The soil is a heavy stiff clay. Irrigation is provided from a temporary dam in the Jementah River, which flows through the Station.

In relation to soil and other factors, the conditions resemble closely those obtaining in padi areas in the Segamat District, which it is intended to serve.

In the Jementah area strong winds blow up and down the valleys and cause lodging. None of the improved strains tried out so far are sufficiently strong in the straw to withstand these high winds.

Of the strains tried at this Station Siam 29, Siam 76, Reyong 6 and Reyong 20 have consistently given high yields.

TENGLU. This Station is situated some 3½ miles north of Mersing on the Mersing-Endau Road, the portion of the Station under padi extending to approximately 4 acres. The soil consists mainly of organic debris overlying heavy clay. When first opened up the organic debris was some 3 to 4 ft. in depth, and the padi when planted appeared to be buoyed up on this. Water supply is dependent on rainfall and drainage is now regulated by a water control gate. Control is not yet satisfactory but conditions have improved considerably since the gate was installed.

The padi land comprised in this Station is typical of the Tenglu area which it is intended to serve.

First opened in 1935 work was confined at the outset to block trials with Radin Siak 17, 24 and 34, Radin 2, Siam 29, Nachin 66, Mayang Ebus 203, Seraup 36, 48, 52, and 146, and three local varieties Lantek, Rakat and Trengganu. Lack of water control had an adverse effect on most of the varieties planted, ripening being very irregular. Those showing most promise were Nachin 66, Siam 29, Radin Siak 34, and Lantek.

In the following season, 1936-37, a commencement was made with Latin Square varietal trials, all the aforementioned varieties being retained with the exception of the Radin Siak strains and Seraup 52, while a fourth local variety, Lembot Tembiling, was added.

Severe damage was done to all plots by *Scotinophara coarctata* and no conclusions could be arrived at from the trials.

Similar trials were carried out in season 1937-38, but again damage by *Scotinophara coarctata* was severe, and this was accentuated by another pest, *Nymphula depunctalis*. No results of any value were obtained.

In view of the experience gained during the first three seasons, it was decided not to undertake critical experimentation until such time as effective control of drainage was possible. Thirteen improved strains and 4 local varieties of padi were planted in blocks during season 1938-39. Yields were slightly better than in the previous seasons, but owing to flooding, lodging and pests damage, little information of value was collected.

Some improvement in water control was effected late in season 1939-40, and trials similar to those carried out during the previous season were repeated, the varieties planted being Seraup 15, Seraup 146, Radin 2, Reyong 6, Mayang Ebus 88, Radin China 4, Siam 29, Siam 76 and Nachin 66. Yields generally showed a decline over those recorded during season 1938-39 and this was attributed to flooding and persistent high winds.

Modifications in the trials for the forthcoming season suggest themselves and these will be put into effect.

BRUNEI.

Approximately 5,000 acres of Wet Padi and 2,000 acres of Dry Padi.

Dry padi is produced under the shifting cultivation system and the cultivation of wet padi is also on comparatively primitive lines. An endeavour is being made in Brunei to increase the area under wet padi and to improve the methods of cultivating this crop and at the same time to discourage the practice of shifting cultivation which has been responsible for much denudation of forest and consequent deterioration of fertility with a totally inadequate compensatory gain in respect of agricultural produce.

Comparative yield trials have been made of a large number of Titi Serong and other pure strains and selection work on local varieties is in progress.

KILANAS. This Station is the main Padi Station in the State. The soil is of two main types, one being deep peat typical of many hundreds of acres at present utilized for wet padi planting and the other a rich alluvial clay. Since its inception in 1933, selection work has been in progress but the 1936-37 season's results were the first which enabled reasonably accurate comparisons to be made. In the light of further experience selection work on the peaty areas was abandoned and in the 1939-40 season was confined exclusively to a newly-opened area of clay soil.

Selection work has not been in progress sufficiently long to allow of any very definite claims to be made for any of the pure lines so far segregated though some of them show fair promise. Some 24 local varieties have been under examination, of which Tibakit, Pulut Merikan and Pulat Sugar have been discarded. The following is a list of the more promising retained for further trial:—

Variety.	Characteristics.	Promising Selections.
Jongkok	Palatable; strong straw; tillers well, high yielders; 7 months; Seraup type of grain.	82A. 92B.
Arat	Palatable; strong straw; tillers well, good yields when grown on peat; 6½ months; very small grain; very prone to bird damage.	3 15
Radin Pasir	Palatable; strong straw, tillers well; 7 months; unsuitable for peat.	12A.
Limbu	As for Radin Pasir.	
Anusan	Allied to a "pulut." Popular with Kedayans but not Bruneis. Suitable for peaty soil. 6½ months.	
Langsat Puteh	Palatable; strong straw; 6 months; unsuitable for peat.	
Langsat Kuning	As above with the additional reputed characteristic of seldom suffering from bird damage.	

The following pure strains have been under trial at the Station:—Seraup 15, 26, 48, 146, 371; Milek Kuning 3; Mayang Kuning 48; Radin 2, 4, 11, 13; Siam 29, 76; Reyong 6, 20; Mayang Ebus 80, 88; Radin Siak 7, 17, 18, 24; Nachin 66.

In comparative yield trials on the Station the Seraup strains and Mayang Kuning 48 have consistently given higher yields than local varieties and both the Seraup strains and Mayang Kuning 48 are suitable for distribution where a 7 to 8 months padi is desired.

PAYA BAKONG (4 acres). This Station replaces the former Berkakas Station which was abandoned owing to its liability to floods. It is situated in the Berkakas District.

In the 1939-40 season some cultivation experiments were laid down to ascertain the effect of removing a 2 to 3 ft. surface layer of peat and to test the relative merits for the area of ploughing as compared with trampling by buffaloes, an alternative method of preparing land for padi in several localities in Pahang and elsewhere. These first-season experiments were a complete failure owing to heavy attacks of pianggang (*Leptocorisa acuta*) which destroyed the entire crop.

LUMAPAS (4 acres). This Station is situated on the Lumapas Road near the Limbang (Sarawak) border. A dam in a small stream provides irrigation for the Station, but the crop elsewhere in the District is not supplied with irrigation.

The District of Lumapas contains a large area of very fertile land and good padi crops are produced, though the crop suffers in some seasons from lack of any controlled water supply.

Pure strains of Seraup, Mayang Kuning, Milek Kuning, Siam, Radin, Mayang Ebus. Reyong and Chubai as well as several local varieties have been used in Latin Square trials on the Station. The Seraups and the local varieties of Jongkok and Limbu have consistently given high yields and appear to be the best of those tried in this respect.

Cultivation experiments have so far failed to show any difference in results as between ploughing and trampling with buffalo.

Some 900 gantangs of seed padi, chiefly of Seraup pure strain, have been distributed from the Station.

KUALA ABANG (4 acres). This Station, opened in the 1935-36 season, is situated in the Ulu Tutong District on the left bank of the Sungei Abang, approximately half a mile from its junction with the Sungei Tutong. The District is largely undeveloped.

The Station has not been a success, the crop having been a failure in every season up to the present.

LABUAN.

940 acres of Padi.

BUKIT KALLAM (2½ acres). This small padi Station is part of the Agricultural Station of the same name and serves as a focus of interest for the padi cultivators. Comparative yield trials indicate that 3 pure strains selected from local varieties are as good as, if not better than, any of the imported strains tried on the Station. These local selections are Siam 53, 64 and Acheh 2.

Selected Articles.

FARMING WITHOUT SOIL*

In the November, 1940, number of this Journal we drew attention to two publications on the subject of growing plants without soil. In these reviews we pointed out that at least under Malayan conditions the practical value of hydroponics was problematical and that it was unlikely that the results obtained elsewhere could be duplicated in this country where climatic conditions are so different. Sir John Russell, the author of the following article, summarizes the claims for this method of plant culture and discusses its limitations under conditions in the United Kingdom.—Ed. M.A.J.

In the days before the War, which now seem to us so incredibly peaceful and remote, we were suddenly startled by Press announcements that an American professor had discovered how to farm without soil, and visions were evoked of intensive methods that would revolutionize crop production. One journalist went so far as to assert that all the wheat needed by Great Britain could, on this new method, be grown on an area the size of Euston Station.

When details became available the method proved to be the growth of plants in culture solutions, familiar to generations of botanical students under the name "water cultures," and the fantastic claims had been arrived at by multiplying the area of the water culture vessel sufficiently to convert the square centimetres into acres. The claims must have been very embarrassing to Prof. Gericke, the originator of the method(1), and indeed the Department of Plant Physiology of the University of California with which he is associated took the unusual step of issuing a statement with the purpose of damping irresponsible enthusiasm and restoring some sense of perspective to what was actually an interesting application of botanical science.

It is unnecessary to remind botanists that perfect plant growth is possible in culture solutions provided the proper nutrients are given and certain conditions are maintained. The difficulty is to pass from the small scale of the laboratory to the large scale of the commercial market gardener and farmer, and only those who have had to make this transition know what it means. Prof. Gericke has shown how the large-scale grower can carry out water culture; he has worked out the conditions for a number of typical American crops, and indicated the difficulties likely to arise. Those with much experience of water cultures know the difficulties of getting really good results in the laboratory.

The nutrient solution must contain not only the six or seven classical elements needed in relatively large quantities, but also those elements needed in small amounts only, especially iron, boron, manganese, copper; but as these trace elements are harmful in larger quantities it is necessary to use purified salts in research work.

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* By Sir John Russell, F.R.S., Rothamstead Experimental Station. *Nature.* Vol. 146, No. 3701, October 5, 1940.

Due regard must also be paid to the changing requirements of the plant as it develops, arising from the circumstance that a given nutrient has different effects at different stages of the plant's life, while the reaction of the medium must also be controlled, as it tends to change during plant growth, and if, as often happens, it becomes alkaline, the iron is precipitated. The air supply to the roots is of vital importance, and steps must be taken to avoid the growth in the solution of algae, bacteria and other micro-organisms which interfere with the proper course of the experiment. One looks to see how these difficulties are met, but apparently they cause less trouble on the large scale than in the laboratory. Prof. Gericke finds it necessary to have only one basic formula for all his crops, the salts need not be pure, no special precautions are taken about mixing them and neither aeration nor growth of micro-organisms in the solution caused trouble. Further, the solutions need not be changed frequently as in good laboratory practice; in some cases they even remained in use for a year. Distilled water, so essential in laboratory cultures, is obviously out of the questions; tap or well must be used instead, but so long as this is not heavily charged with salts it does not seem to affect the procedure.

The process is not, however, entirely simple. Iron may be thrown out of solution, or be present in inadequate amounts, and during the course of growth there may arise deficiencies of other elements. These could be detected by chemical analyses, but a simpler procedure is possible: the plant itself shows up the deficiencies by fairly characteristic symptoms which a good grower soon learns to recognize. These symptoms are described and illustrated, and this section gains in interest from the fact that the plants include some such as rice and cotton, which are not usually grown in laboratory exercises in Great Britain.

While recognizing the author's wide experience with water cultures, one cannot help wondering whether the absence of these and other difficulties may not in part be attributable to the clear and sunny skies of California, and whether large-scale experience would be equally fortunate in Great Britain, where conditions of temperature and light are often so different.

In a recently published book([2]), details are given to help the grower. In laboratory practice the seeds are germinated in sand, sawdust, or moist blotting paper. On the large scale a seed bed is used, consisting of a tray of wire netting of one inch mesh and 19 or 20 gauge held on a frame 6-12 ft. long by 2-4 ft. wide, and containing moist litter-peat, fine wood shavings (wood wool), chaff, etc. After germination the seeds push their roots through the wire; the tray is then placed over the solution, and the roots dipping into it absorb the nutrients and proceed to elongate. In the laboratory water cultures are by long custom made in glass vessels—usually bottles—each containing one plant. On the large scale basins are used; so far it is not certain whether the best material is concrete, wood, sheet metal or such cheaper materials as troughs dug in the earth and lined with puddled clay. For all of them satisfactory results are claimed, especially after they have been in use, so that harmful substances have been dissolved out; in the case of metals, coating with asphalt enamel may be desirable. The whole problem of root aeration

is avoided by the simple expedient of restricting the depth of the basin to six inches, and allowing sufficient space between the surface of the solution and the crown of the root to ensure movement of air. This depth also permits of evaporation and transpiration of about half the solution without detriment to plant growth. Greater depths required more of the chemicals and presented no corresponding advantage. Some of the basins described were up to 150 ft. long and 50 ft. wide.

The new method is complicated by the circumstance that each crop requires rather special treatment. Experience in ordinary cropping is no guide: two species, the author tells us, which behave similarly in soil might differ markedly in their reaction to water culture. There is also, he says, much less margin of safety in water culture than in soil; the solution "has a much lower resistance to chemical change than does the soil." Detailed instructions for a number of crops are given. The management of the seed bed is particularly important: it must be kept sufficiently but not excessively moist and the temperature conditions must be right. The crops must be closely watched for deficiency symptoms: lack of iron is made good by adding ferrous sulphate, lack of other elements apparently by adding more of the basic mixture.

Tomatoes are said to be among the best 'subjects,' and some glowing descriptions are given of results obtained. In good glasshouse practice in England yields run about 6 lb. of fruit per plant: the author claims an average yield of 16 lb. and his highest yield was 27.4 lb. Potatoes in Great Britain average about 7 tons per acre, but a good grower will not uncommonly obtain 12 tons per acre: the author claims 48 tons per acre. Obviously if results of this order were generally obtainable the new method would revolutionize food production.

Incidentally, Prof. Gericke claims that the produce obtained by the new method is of high quality and of full nutritive value, thus ranging himself against those who regard humus as necessary for healthy crop production.

All those who have long been associated with agriculture are familiar with claims of new and vastly improved methods of production periodically put forward: after a short period of public interest they practically all faded away: on the large scale they did not work. It still remains to be seen what will happen to this latest addition to the list. Three tests have already been made in Great Britain by competent and recognized authorities. From the Cheshunt Experimental Station([3]), which specializes on crop-growing under glass, and has had very wide experience with tomatoes and cucumbers, it is reported that the new method yielded 3-4.7 lb. of tomatoes per plant according to the variety, this being lower than is obtained in ordinary soil culture, but 160 lb. of cucumber per plant, as against about 50 lb. in normal practice. Millard and Stoughton at Reading([4]) obtained as good yields of tomatoes with the new method as with the old, and better results with gladioli; they could, however, find no evidence of the high yields claimed in California, and doubt whether English conditions of light and carbon dioxide supply would permit

of them. Templeman and Watson([5]) did not obtain as good yields as in soil. All these experiments go to show that in English conditions, at any rate, the method is not as promising as is claimed, though it may still have its uses for special purposes.

Among these may be town gardening. A Pelican Special has been issued giving in diary form Mrs. Hillyer's trials made for amateurs at her house in Hampstead, and therefore likely to appeal to townspeople who are interested in gardening and are fond of trying something new, but who lack garden space([6]). It is evident that she enjoyed the work, and her energy and enthusiasm enabled her to overcome many difficulties. In her view the new method provides a fascinating hobby, and indeed she thinks it offers "immensely more." The *Daily Mail* has given her space on the roof of its offices, and the services of its expert, Mr. Izzard. Here at least may be possibilities for development.

1. *Nature,* 141, 536 (1938).
2. The Complete Guide to Soilless Gardening. By W. F. Gericke. Pp. xvi+285. (London: Putnam and Co., Ltd., 1940). 12s. 6d. net.
3. Annual Report, 1939, p. 13.
4. *Sci. Hort.,* 7, 174 (1939).
5. *J. Min. Agric.,* 1938-39, 45, 771 (1938-39).
6. Hydroponics: Food without Soil; a Journal of Experiments, 1938 to 1940. By Isabel Hillyer. (Pelican Special S63). Pp. 116. (Harmondsworth, Middx., and New York: Penguin Books, Ltd., 1940). 6d. net.

EFFECT OF ARTIFICIAL FERTILIZERS ON THE NUTRITION VALUE OF THE PLANT. *

From time to time the idea keeps cropping up that the use of chemical fertilizers is an "unnatural" expedient used by man to force his crops into "unnatural" growth, and thus tends to produce "unnatural" foods that may, in the long run, have harmful effects upon the animals or human beings that consume them. The suggestion is a difficult one to disprove, if only because it is usually made in a very vague and indefinite form. Thus it is useless to show that wheat grown with sulphate of ammonia and superphosphate has the same general composition as other wheat grown with dung or with the residues of the sheepfold; the difference may be one that does not show up in a chemical analysis. Again, it is useless to point out that an application of slag to a sheep pasture may lead to an obvious improvement in the health and growth-rate of the sheep; that may well be true, but it may equally be true that there has been, at the same time, some obscure but nevertheless real deterioration in the food value of the mutton.

It is, of course, a well-known fact that the use of unbalanced manures, either natural or artificial may have harmful effects on the nutritive value of a crop. Thus the excessive use of nitrate on a hay meadow may favour the coarse and innutritious grasses at the expense of the wild white clover and other desirable species; or the repeated use of sulphate of ammonia may cause the depletion of the lime reserves of the soil and thus produce a lime-deficient herbage that fails to satisfy the calcium requirements of the animal. These, however, are merely examples of harm arising from the wrong use of artificials.

An interesting experiment† that bears on the broad general question has recently been reported from the Veterinary Physiological Institute of the University of Leipzig. Two groups of rats were fed, for six successive generations, upon diets corresponding closely to an ordinary mixed human diet, the only difference being that for one group (Group V) all the constituents of the ration had been produced with the use of chemical fertilizers, while for the other (Group U) the ingredients had all been produced without resort to artificials. For instance, the one group had beef from cattle fed on intensively manured pasture, while the other had the meat of cattle that had never consumed fodder grown with artificials. The diet was a good and very mixed one, including cereals (oats, barley and rye), vegetables (lettuce, spinach, cabbage, beans, peas, carrots, celery, tomatoes and potatoes), meat and milk. The conditions of the experiment seem to have been carefully controlled and the individual rats distributed at random between the two lots.

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* By J. A. Scott Watson, M.A. Sibthorpian Professor of Economy, Oxford, in the *Journal of the Ministry of Agriculture*, Vol. 42, No. 9. 1935.

† Biochem. Zeit, 1934, 5-6. Summary in the Jealott's Hill Agri. Res. Bull. Vol. IV No. 3, March, 1935

Most people would probably predict a negative or inconclusive result from such a test. Somewhat surprisingly, there were significant differences between the two groups, the differences being all in favour of Group V (artificials). The V-group rats of the parent generation seemed to be definitely more resistant to disease, and lived longer; of the first-generation progeny, Group V showed better general health, and the females continued to breed to greater ages; and taking all the generations the V group were more prolific and more vigorous.

These results should not, of course, be taken as suggesting that artificials are better than animal manures. The real explanation may possibly be that the farmer who uses artificials (in conjunction with dung, etc.) does, upon the whole, arrive at an improved balance of plant nutrients in the soil, and that this results in the production of a plant that, regarded as animal food, has an improved balance of minerals.

Notes and Comments.

SPECIES OF CARPET GRASS.

Mr. R. B. Jagoe in *The Gardens' Bulletin Straits Settlements* Vol. XI. Part 2, describes and illustrates the two distinct species of carpet grass in Malaya. He summarizes the chief distinguishing features as follows:—

Axonopus compressus Beauv. (Savannah grass).	*Axonopus affinis* Chase. (Carpet grass).
Leaves.—Broad, hairy, frequently with red colouration.	Narrower, stiff, folded, more or less glabrous.
Nodes.—Very hairy.	Hardly hairy.
Spikelets.—Long and pointed.	Blunt or short pointed.
Anthers.—Yellow with narrow purple outer edges.	Purple, with translucent dots.
Stigmas.—White.	Mauve.

A. affinis withstands dry weather better than *A. compressus* and is capable of covering the soil better in dry exposed situations. On poor, unshaded soil, in this country, the former species frequently grows by densely-leafy, short internoded stolons, and it is probable that it will, in time, largely predominate in such conditions.

Under medium shade, however, where both make their best growth, *A compressus* appears to have a distinct advantage.

There is some slight confusion as to palatability and value of carpet grass as pasture, but this is probably due to the previous confusion of two species with but one name.

There is no doubt that the true *A. compressus* Beauv. is a good pasture grass, being recognized as such in tropical America and Australia. It appears equally true that *A. affinis* has a variable reputation. It is definitely regarded as inferior in Australia, and chemical analyses quoted by McLennan clearly show it to be inferior, as fodder, to *A. compressus*.

In Malaya, a few years ago, *A. affinis* appeared to be liable to cause purging of cattle, due to slight increase in hydrocyanic acid content if cut at too frequent intervals. The author has, however, seen *A. affinis*, under light shade, grazed by cattle with relish, and obviously in preference to *Paspalum conjugatum*.

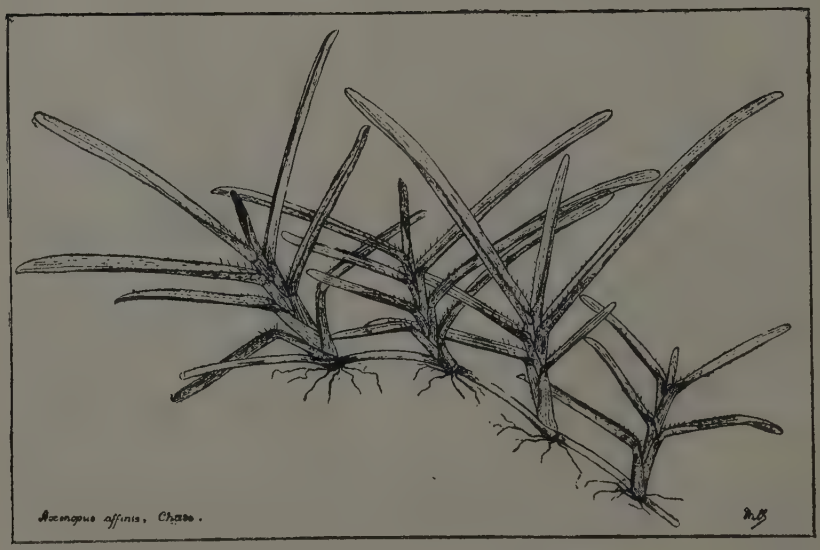
THE SOYABEAN IN AMERICA.

The *Reader's Digest* of September, 1940, contains an interesting account, condensed from *Forbes*, August 15, 1940, on the development of the soyabean industry in the United States.

Axonopus affinis, Chase.

Axonopus compressus, Beauv.

Axonopus compressus - Beauv


Axonopus affinis, Chase.

About 1921 there was an import of 15,000 tons, the oil being used mainly in paints and lacquers, the cake as a meal for feed. By 1924 the Illinois soyabean acreage was ten times that of 1921; the oil was found to be excellent for making oleomargarine and salad dressings, while increased use of the meal in livestock feeds absorbed available supplies. Production not only quickly replaced imports, but grew to a volume far in excess of the former total consumption.

Soyabean contains 40 per cent. highly digestible protein and 20 per cent. fat. Of the oil produced, 85 per cent. now goes into human food products, the rest into paints, lacquers and soaps, while about 95 per cent. of the meal goes into livestock feed. New uses are constantly being found for soyabean products, but the bulk of the crop is still used for food, feed, and paint.

There is no sign that the potential market for soyabean in the United States is near saturation. The Government estimates a 17 per cent. increase in acreage in 1940, which means a 100,000,000 bushel harvest, while it is believed that present markets can absorb from 50 to 100 per cent. more than present production. In any event, soyabeans will probably be one of the agricultural crops of the U.S.A. without a surplus for some time to come.

In the Mid-western States there is now a soyabean belt comparable to the one in Manchuria. The development of this industry is not without its effect on the American demand for copra as these two products are to a great extent interchangeable in commerce. While American supplies of copra and coconut oil are mainly from the Philippines the indirect effect of this competitive product must of course be felt by copra producers in other countries, so that in the extension of the soyabean industry in America we see another factor likely to depress the market for Malayan copra.

A MANUAL OF TROPICAL CITRUS CULTURE.

Recent publications of the Department of Agriculture, Ceylon, have indicated considerable interest in the possibilities of citrus culture in that country. The lime thrives from sea-level to an altitude of 3000 ft., especially in the dry region if irrigation is provided. The grapefruit is best suited for low and mid-country districts from about 1500 to 4000 ft. altitude. In the mid-country semi-dry zone (2000 to 4000 ft.) the sweet orange and mandarin oranges succeed, whereas the former on the plains produces a coarse thick-skinned fruit.

For the most part, the climate of Malaya is unsuited to the cultivation of the citrus fruits, our seasons being too indefinite and with an absence of a well-defined long dry season. This applies in particular to the whole of the western part of the Peninsula. In the north, however, Kedah, Kelantan and Trengganu provide more suitable conditions, especially for the mandarins. We remember also having seen very fair samples of grapefruit grown in Perlis.

Matter of interest in this connexion may be found in a recently-published book "A Manual of Tropical Citrus Culture" by Mr. C. C. S. Stephenson, a pioneer citrus planter in Ceylon. The author has established the first orange farm in Ceylon and has had some success. His methods and opinions, therefore, will be treated with respect and may be of value to others developing land for the same purpose under somewhat similar conditions.

THE MALAYAN NATURE JOURNAL.

The articles in the second number of *The Malayan Nature Journal* maintain the high standard of excellence set in the initial issue. The principal articles cover a wide field of observation, including birds of Penang and Province Wellesley, Malayan pitcher plants, poisonous snakes, Malayan mammals, notes on the Pompilid wasp, on the Christmas Island Frigate bird and on the Japanese martin. An eloquent plea, supported by photographic records, for the preservation of national beauty spots of Malaya, calls for particular mention.

The list of members indicates that the Malayan Nature Society has attracted considerable attention, but there must be many more people, particularly Asiatics, to whom the Society should have an appeal, while the publication should be of considerable benefit to many of the English schools in this country.

Departmental.

FROM THE DISTRICTS.

Compiled in the Office of the Chief Field Officer from Monthly Reports of Agricultural Officers.

December, 1940.

The Weather.

During the first part of the month the weather continued to be wet. In western areas the latter half of the month was dry and sunny. Heavy rain fell in Kelantan throughout the month. In Pahang also the wet weather continued.

Crop Reports.

Rubber.—Prices remained unchanged compared with the previous month: $46 to $48 for smoked sheet. Wages have increased, tappers employed on small estates and holdings in Selangor receiving 10 to 12 cents per kati of dry rubber. Many more holdings have now been brought into tapping.

In conjunction with the Co-operative Marketing Officer the Asiatic Rubber Instructor, Ulu Langat, has initiated courses in tapping for unemployed Malay youths at Jenderam and Beranang, Selangor.

Padi.—In North Kedah a large proportion of the crop is now ripening. Considerable areas of early maturing padi have already been reaped. The complete cessation of the normal labour supply from Patani is naturally causing a shortage of harvesting labour this year, and cultivators are finding it difficult to get their crops harvested. Efforts are being made to obtain labourers from other neighbouring territories and it seems likely that the difficulty will be satisfactorily solved.

Reports of rat damage have been received from Krian and from many parts of the country, and it seems likely that rat damage will be more severe than usual this season. Every effort is being made to control the pest by poisoning, trapping and gassing. Unfavourable weather early in the season resulted in planting operations being held up so that the crop is now in widely varying stages of maturity, and this has also handicapped rat control measures.

In Krian, though growth is slightly better than last year, the actual crop will probably be much the same on account of greater rat damage.

In the Sungei Manik area little damage was done by the floods in Stage III mentioned last month and most of the padi that was submerged will recover. In Stage IV, however, damage was severe and it is feared that only some 200 to 300 acres have survived. Although the floods have now subsided it is still difficult to get about in this area and it is not possible to estimate accurately the area of

padi remaining. Many of the settlers have left the area, but it is hoped that by offering them employment on drainage and irrigation work within the area they may be induced to return and carry on until next season.

In Selangor, padi in most inland areas has been reaped and the yield is reported to have been quite good. The present position in the large areas being developed in Kuala Selangor and Sabak Bernam is given below:

			Old Area acres.	New Area acres.
Kuala Selangor:	(1) Sempadan	...	1,600	2,500
	(2) Sungei Burong	...	500	700
	(3) Sekinchang (Chinese area)	...	—	512
	(4) Pasir Panjang	...	240	—
	(5) Sungei Nipah	...	—	2,000
			2,340	5,712
	Total	...	8,052 acres	
Sabak Bernam:	Panchang Bedena and Sungei Panjang	...	11,022	
	Total	...	19,074 acres	

In the Sempadan area transplanting has been very uneven and in some areas it has been necessary to transplant more than once owing to alternate floods and droughts. At Sekinchang flooding of the area held up felling and clearing of the jungle so that it has not been possible to plant as large an area as was expected; 500 acres have been planted by broadcasting. Broadcasting was the method also employed at Sungei Nipah. At Panchang Bedena and Sungei Panchang transplanting is completed. The general condition of the crop in this area is reported to be quite good.

The lack of an adequate water supply has resulted in some 2,000 acres of rice land in Kuala Pilah District remaining uncultivated.

The crop in inland areas in Malacca has made good growth and looks very promising. In coastal areas of the Central District the crop will again be a poor one.

It seems that the Pahang crop will be below normal. Here again rat damage is reported to have been more severe than usual.

Coconuts.—Copra prices continue to be very low, $2.40 being the price quoted in Singapore for f.m.s. loose. In Johore the price is $1.70 to $1.80. In Kuala Selangor the advent of a new dealer has caused competition which has been of benefit to growers in this area, prices of between $2 and $2.35 per picul being paid.

Pineapples.—The future of the pineapple industry continues to be uncertain. Factories operated for only a few days during the month. Every effort is being made to find new markets for canned pineapples to replace those which are for the present closed as a result of war-time trade restrictions. A large quantity of canned pineapple has already been supplied to the troops in Egypt and the Middle East.

Poultry.—A trial has been in progress at Agricultural Stations for several months past to test pure Rhode Island Reds, crossbreds and *kampong* fowls when kept under *kampong* conditions and fed on a cheap ration which would be within the means of the Malay small-holder. In some instances epidemic disease broke out and put an end to the experiment. In other cases the experiment has now continued long enough to give results. The cross-bred birds have proved hardy and good layers and have created considerable interest among Malays and Chinese visiting the Stations. At Bukit Mertajam Agricultural Station the last period (24 days) recorded gave the following results:

R.I.R.	10	birds	laid	80	eggs	(8	eggs	per bird)
Crosses	27	,,	,,	200	,,	(7.4	,,	,, ,,)
Kampong	49	,,	,,	274	,,	(5.6	,,	,, ,,)

DEPARTMENTAL NOTES.

Leave.

Mr. J. Fairweather, Agricultural Officer, has been granted 231 days leave from 21st December, 1940, to 8th August, 1941, inclusive.

Mr. E. J. H. Berwick, Agricultural Officer, has been granted 288 days leave from 12th December, 1940, to 25th September, 1941, inclusive.

Mr. G. E. Mann, M.C., Principal, School of Agriculture, Malaya, returned from leave on the 3rd January, 1941.

Statistical.

MARKET PRICES.

December, 1940.

Major Crops.

Rubber.—There was a certain amount of fluctuation in the Singapore market price during the month. No. 1. X. Ribbed Smoked Sheet opened at 38¼ cents per lb., advanced to 39 cents on the 10th December, thereafter weakening steadily to close at 37¾ cents.

The average of daily quotations for the month was 38.35 cents per lb., as compared with 38.69 cents in November. The London average price was 11.93 pence per lb., and New York 20.65 cents gold, as compared with 11.78 pence and 20.72 cents gold in November.

Prices paid for small-holders' rubber at three centres during the month are given in Table 1.

Table I.

Weekly Prices Paid by Local Dealers for Small-Holders' Rubber, December, 1940.

(Dollars per picul of 133 1/3 lbs.)

Grades	Kuala Kangsar, Perak				Kuala Pilah, Negri Sembilan			Batu Pahat, Johore.			
	4	11	18	25	5	12	19	4	11	18	25
Smoked Sheet ...	46.00	46.00	46.34	46.00	46.80	47.00	46.50	45.50	45.95	45.50	—
Unsmoked Sheet ...	43.30	42.30	42.69	43.00	—	44.00	44.00	—	44.16	—	43.00
Scrap ...	—	—	—	—	—	—	—	—	—	—	—

Transport by F.M.S.R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8 per ton.

Transport from Batu Pahat to Singapore by lorry, excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

No purchases of rubber at Kuala Pilah on the 26th December.

Palm Oil.—No recent information is available regarding prices paid in the United Kingdom.

Local sales of palm oil in sellers' drums were made during December at the following prices:—bleached oil 6 per cent. f.f.a. $124 per ton f.o.b. Singapore; 5 per cent. f.f.a. $123 per ton f.o.b. Port Swettenham; unbleached oil 8 per cent. f.f.a. $113 per ton f.o.b Singapore; 6 per cent. f.f.a. $113 and $115 per ton f.o.b. Port Swettenham; 5 per cent. f.f.a. $108, $113/114 per ton f.o.b. Port Swettenham.

Copra.—The sun-dried grade was quoted throughout the month at $2.40 per picul and the mixed grade at $2.15. The November average prices were $2.43 and $2.18 respectively.

Coconut oil was sold in Singapore during the month at an average price of $7 per picul.

Copra cake is quoted at $2 per picul.

Rice.—The Singapore average wholesale prices of rice per picul in October, 1940, were as follows:—Thailand No. 2 Ordinary (3rd Grade "A") $6.92, Thailand No. 1 Broken (White) $6.52; Thailand No. 2 Broken (White) $6.17, Rangoon No. 1 (S.Q. Meedone) $6.42, Rangoon Parboiled No. 2 (Milchar No. 2) $6.17, Saigon No. 1 (Long Grain) (Annam White Rice No. 1) $6.42.

The October average retail prices in cents per gantang (gallon) of No. 2 Thailand rice were: Singapore 36, Penang 36, as compared with 33 and 34½ respectively in September. Malacca is not quoted.

The average declared trade value of imports during October was $5.48 per picul, as compared with $5.04 in September and $4.63 in August.

Padi.—The Government Rice Mills, Perak, are paying a guaranteed price of $2.50 per picul for padi, plus a bonus of 10 cents per picul for pure strain S.K. 48 padi. The Government Rice Mill, Temerloh, Pahang, continued to pay $2.25 per picul.

Retail prices of padi in cents per gantang (gallon) were as follows:—Kedah 9.8, Penang and Province Wellesley 17, Perak Central 12 to 18, Perak South 16 to 18, Pahang 11½ to 22, Negri Sembilan 15 to 22, Malacca 14 to 16, Kelantan 12½ to 13.

Pineapples.—Prices for the canned product and for fresh fruit remained unchanged during December.

Beverages.

Tea.—There are no London tea sales.

The latest Colombo prices available, quoted from *The Ceylon Tea Market Report* of 31st December, 1940 of the Colombo Brokers' Association are as follows, in rupee cents per lb.: High Grown Rs. 1.06, Medium Grown 89, Low Grown 81.

Coffee.—Liberian coffee rose in Singapore from $15 to $15.50 per picul at the close of the month, averaging $15.12. Excelsa and Robusta were quoted throughthe month at $11.50 and $8 per picul respectively.

The average of highest and lowest quotations in Singapore for Palembang coffee was $13.25 to $15.88, and for Sourabaya coffee $15.81 to $17.81. The November average prices were $13.31 to $15.44 and $16 to $18.31 respectively.

Spices.

Arecanuts.—The averages of the Singapore Chamber of Commerce quotations per picul, which were stated to be approximate, were:— Best $6.23, Medium $5.90, Mixed $5.46, as compared with $6.55, $6.15 and $5.60 respectively in November.

The averages of the highest and lowest quotations per picul in Singapore were as follows:— Splits $5.06 to $7.06, Red Whole $4.56 to $6.75, Sliced $9.06 to $11.38, as compared with $4.94 to $7.69, $7.62 to $9.50 and $8.94 to $11.69 respectively in November.

Pepper.—Singapore Black continued unchanged at $6.25 per picul, and Muntok White improved to be quoted throughout the month at $13.25 per picul, as compared with an average of $12.80 in November. Singapore White is not quoted.

Nutmegs.—Prices fell back in December. 110's fell from $26 to $24 per picul, averaging $24.75, and 80's fell from $28 to $25, averaging $26. The November averages were $22 and $23.80 respectively.

Penang dried nutmegs were sold at $14 per picul.

Mace.—The market was a nominal one with no quotations.

Locally produced mace, dry, was sold in Penang at $40 per picul.

Cloves.—A nominal market with no quotations. Penang cloves, dried, sold in Penang at $55 per picul.

Cardamoms.—Green cardamoms were quoted in *The Ceylon Chamber of Commerce Weekly Report* of 16th December, 1940, from Rs. 1.27 to Rs. 1.72 per lb.

Miscellaneous.

Derris.—Early in December there were indications that manufacturers' requirements for the coming season were to a large extent provided for. Roots were more freely available, as a result of which prices weakened slightly. Average prices per picul for the month were as follows:— $9 to $10.50 for roots sold on a basis of ether extract; $18 to $22.50 for roots with 4 to 5 per cent. rotenone content, rising to $27 to $28 for 7 to 9 per cent. rotenone.

Gambier.— No. 1. Cube was quoted throughout the month at $14.50 per picul, as compared with $14 in November. Block was not quoted.

Sago.— Pearl fell from $8 to $7.75 per picul at the close, averaging $7.94 as compared with $6.55 in November. Flour, Sarawak Fair, improved to open at $4.50 at which figure it was quoted throughout the month. The November average was $3.50.

Tapioca.— There was a slight fall in values except of Medium Pearl. The following were the prices per picul quoted throughout the month:— Flake Fair $6.50, Seed Pearl $7.25, Medium Pearl $8, as compared with November averages of $6.60, $6.80 and $7.40 respectively.

Tobacco.—Prices of prepared tobacco per picul in Kelantan during December were: 1st quality $100 to $170, 2nd quality $60 to $135, 3rd quality $30 to $115. The range of dried leaf prices per picul was as follows: Kedah $42; Penang and Province Wellesley $40, $31; Perak Central 1st quality $35 to $38, 2nd quality $18 to $31, 3rd quality $12 to $20; Perak South $45, $40, $35 (prepared tobacco 70 to 75 cents per kati); Pahang $25 to $30, $15 to $20, $10 to $16 (cut tobacco Pahang South 80 to 96 cents per kati); Negri Sembilan $25 to $30, $20 to $28, $10 to $18; Malacca $35.50 to $37.50; Selangor, cut tobacco $1 to $1.30 per kati.

The above prices are based on London and Singapore daily quotations for rubber, on the Singapore daily prices for copra, on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports and certain coffee prices are kindly supplied by Guthrie & Co., Ltd., Kuala Lumpur, local palm oil prices by Whittall & Co., Kuala Lumpur, the Singapore prices of imported coffee and arecanuts by Lianqui Trading Company of Singapore, and Singapore derris prices by Hooglandt & Co., Singapore.

1 picul = 133 1/3 lbs. The dollar is fixed at 2s. 4d.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57, Trafalgar Square, London, W.C.2.

FERTILIZER PRICES, JANUARY, 1941.

The following are the prices current for the month of January, 1941, of the more important fertilizers of which stocks are available.

	per ton $
Nitrate of soda	125
Muriate of potash	200
Rock phosphate (Christmas Island)	37 ($35 Singapore).
Lime	20

Quotations are *ex* warehouse, Port Swettenham, Klang, Singapore and Penang.

Supplies of sulphate of ammonia, superphosphate, basic slag, calcium cyanamide, sulphate of potash, and rock phosphate (Gafsa) are not available.

MALAYAN AGRICULTURAL EXPORTS, NOVEMBER, 1940.

Product	Net Exports in Tons				
	Year 1939	Jan./Nov. 1939	Jan./Nov. 1940	November 1939	November 1940
Arecanuts ...	38,489	36,439	41,447	3,317	3,550
Coconuts fresh†‡ ...	97,275†	90,445†	111,270†	7,739†	24,469†
Coconut oil‡ ...	61,360	56,264	63,366	6,157	6,946
Copra‡ ...	34,420	43,391	10,015*	1,252	3,062*
Copra cake ...	10,707	10,961	2,881	3,317	344
Gambier, all kinds ...	1,572	1,403	782	102	138
Palm kernels ...	10,774	9,013	8,778	675	489
Palm oil ...	59,712	55,118	48,738	6,039	5,986
Pineapples, canned ...	65,802	80,646	34,760	3,722	1,793
Rubber¶ ...	361,484¶	328,729¶	494,561¶	32,653¶	41,350¶
Sago,—flour ...	9,583	8,124	3,165	269	122
,, —pearl ...	3,883	3,407	4,006	264	389
,, —raw ...	4,435*	4,245*	4,660*	1	170*
Tapioca,—flake ...	1,068	939	680	83	36
,, —flour ...	2,706*	1,932*	2,231*	63	150*
,, —pearl ...	18,277	17,446	15,691	2,255	2,186
Derris ...	1,356	1,207	1,098	171	109
‡Copra equivalent ...	136,075	136,629	97,820	11,412	9,004

† hundreds in number. * net imports. ¶ production.

MALAYAN PRODUCTION OF PALM OIL AND KERNELS

(In long tons, as declared by Estates).

Month 1940	Palm Oil			Palm Kernels		
	F.M.S.	U.M.S.	Malaya	F.M.S.	U.M.S.	Malaya
January ...	2,007.6	2,474.0	4,481.6	434.3	497.0	931.3
February ...	1,937.9	1,914.7	3,852.6	411.1	454.0	865.1
March ...	2,081.5	1,877.0	3,958.5	445.3	388.1	833.4
April ...	2,104.3	1,820.7	3,925.0	420.8	370.0	790.8
May ...	2,124.3	2,054.1	4,178.4	414.5	401.0	815.5
June ...	2,128.8	2,696.0	4,824.8	268.6	505.0	773.6
July ...	3,217.7	2,886.4	6,104.1	531.4	529.2	1,060.6
August ...	3,801.2	3,049.9	6,851.1	343.1	389.8	732.9
September ...	3,323.7	2,490.6	5,814.3	296.1	294.0	590.1
October ...	2,747.4	2,459.3	5,206.7	381.6	464.0	845.6
November ...	2,351.9	2,504.8	4,856.7	344.7	462.0	806.7
Total ...	27,826.3	26,227.5	54,053.8	4,291.5	4,754.1	9,045.6
Total January to November, 1939 ...	27,898.8	24,278.3	52,177.1	5,214.5	4,011.1	9,225.6
Total for the year 1939 ...	30,157.7	27,215.0	57,372.7	5,639.3	4,533.1	10,172.4

Stocks on estates as at 30th November, 1940, were :— palm oil 7,898 tons, palm kernels 1,291 tons.

ACREAGES OF TAPPABLE RUBBER ACTUALLY TAPPED AND NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 30TH NOVEMBER, 1940.

State or Territory	Estimated Acreages of Tappable Rubber (9)+(11)	Acreages of tappable rubber not tapped: On estates which have entirely ceased tapping		On estates which have partly ceased tapping (a)		Area of tappable rubber never been tapped (b)		Total area not tapped (3)+(5) (c)		Total area tapped during the month		Area of tappable rubber rested under rotational systems (c)	
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)	Acreage	Percentage of 7) to (2)	Acreage	Percentage of (9) to (2)	Average	Percentage of (11) to (2)	Acreage	Percentage of (13) to (2)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
S.S.—													
Province Wellesley ...	42,356	114	0.3	5,902	13.9	387	0.9	6,016	14.2	36,340	85.8	8,683	20.5
Malacca ...	113,498	470	0.4	12,556	11.1	741	0.7	13,026	11.5	100,472	88.5	18,674	16.5
Penang ...	2,600	nil	nil	667	25.7	35	1.3	667	25.7	1,933	74.3	60	2.3
Singapore ...	30,195	3,499	11.6	5,621	18.6	328	1.1	9,120	30.2	21,075	69.8	3,091	10.2
Total S.S. ...	188,649	4,083	2.2	24,746	13.1	1,491	0.8	28,829	15.3	159,820	84.7	30,508	16.2
F.M.S.—													
Perak ...	276,213	920	0.3	23,493	8.5	3,810	1.4	24,413	8.8	251,800	91.2	34,015	12.3
Selangor ...	305,058	2,655	0.9	18,493	6.0	2,861	0.9	21,148	6.9	283,910	93.1	36,696	12.0
Negri Sembilan ...	250,895	2,214	0.9	27,238	10.8	3,676	1.5	29,452	11.7	221,443	88.3	25,613	10.2
Pahang ...	85,090	1,211	1.4	10,958	12.9	3,703	4.4	12,169	14.3	72,921	85.7	5,483	6.4
Total F.M.S. ...	917,256	7,000	0.8	80,182	8.7	14,050	1.5	87,182	9.5	830,074	90.5	101,807	11.1
U.M.S.—													
Johore ...	467,062	7,524	1.6	54,151	11.6	22,502	4.8	61,675	13.2	405,387	86.8	53,304	11.4
Kedah ...	195,737	5,041	2.6	9,493	4.8	3,930	2.0	14,534	7.4	181,203	92.6	29,118	14.9
Kelantan ...	30,283	403	1.3	4,316	14.3	793	2.6	4,719	15.6	25,564	84.4	4,404	14.5
Trengganu (d) ...	4,817	nil	nil	nil	nil	nil	nil	nil	nil	4,817	100.0	1,805	37.5
Perlis (e) ...	1,329	nil	nil	345	26.0	76	5.7	345	26.0	984	74.0	232	17.5
Brunei ...	6,075	nil	nil	1,087	17.9	327	5.4	1,087	17.9	4,988	82.1	880	14.5
Total U.M.S. ...	705,303	12,968	1.9	69,392	9.8	27,628	3.9	82,360	11.7	622,943	88.3	89,743	12.7
Total MALAYA ...	1,811,208	24,051	1.4	174,320	9.6	43,169	2.4	198,371	11.0	1,612,837	89.0	222,058	12.3

Notes.—(*a*) Area out-of-tapping on estates which have partly ceased tapping refers to areas definitely being rested and excludes areas on any tapping round.

(*b*) The acreage shown in column (7) is included in columns (3) and (5).

(*c*) Areas of tappable rubber rested under rotational systems are not considered as out-of-tapping and therefore columns (11) and (12) include columns (13) and (14) respectively.

(*d*) Registered companies only.

(*e*) Figures for the quarter ending 30th September, 1940.

MALAYAN RUBBER STATISTICS Table I.

Acreage, Stocks, Production, Imports and Exports of Rubber, including Latex, Concentrated Latex and Revertex, for the month of November, 1940, in Dry Tons.

State or Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports				Exports including re-exports				Stocks at end of month			Consumption 3	
								during the month		January to Nov. 1940		during the month		January to Nov. 1940						
	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. to Nov. 1940	during the month	Jan. to Nov. 1940	Foreign	From Malay States	Foreign	From Malay States	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over	during the month	Jan. to Nov. 1940
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
MALAY STATES :—																				
Federated Malay States ...	...	5,695	16,567	15,966	159,819	4,888	92,553	Nil	Nil	Nil	Nil	10,707	9,361	164,985	93,625	...	5,158	17,767	123	1,011
Johore ...	...	2,703	6,838	7,344	72,146	3,333	57,302	Nil	25	Nil	662	2,709	8,100	39,953	91,713	...	1,983	7,451	...	...
Kedah ...	...	496	3,634	3,913	38,305	1,071	15,214	Nil	Nil	Nil	Nil	1,500	3,363	20,512	35 559	...	369	3,882	...	...
Perlis ...	...	37	28	22	187	28	350	Nil	Nil	Nil	Nil	Nil	42	Nil	528	...	32	41	...	...
Kelantan ...	...	223	491	448	4,614	307	9,213	Nil	Nil	Nil	Nil	180	600	2,285	11,856	...	178	511	...	...
Trengganu ...	...	62	116	199	2,052	328	3,934	Nil	Nil	Nil	Nil	Nil	525	30	6,094	...	35	145	...	...
Brunei ...	...	5	40	64	694	84	1,036	...	...	...	...	...	120	...	1,737	...	11	62	...	...
Total Malay States	...	9,221	27,714	27,956	277,817	10,039	179,602	Nil	25	Nil	662	15,096	22,111	227,765	241,112	...	7,766	29,859	123	1,011
S. SETTLEMENTS :—																				
Malacca ...	...	2,064	1,514	1,615	15,213	538	8,921	Nil		Nil		1,764		30,416		...	1,720	1,674	...	...
Province Wellesley	...	702	697	617	5,933	217	2,872	Nil		Nil		9,143		106,495		...	1,594	744	...	...
Penang ...	4,842	2,242	17	25	249	84	1,172	2,179	19,446	26,586	232,114		Nil		Nil	3,118	3,561	13	...	...
Singapore ...	12,919	13,635	289	188	1,855	61	765	13,965		193,549		26,119		338,526		15,217	11,882	303	15	203
Labuan ...	...	21	Nil	Nil	Nil	10	161	52		643		Nil		Nil		...	20	Nil	...	...
Total Straits Settlements ...	17,761	18,664	2,517	2,445	23,250	910	13,892	16,196	19,446	220,778	232,114	37,026	Nil	475,437	Nil	18,335	18,777	2,734	15	203
Total Malaya ...	17,761	27,885	30,231	30,401	301,667	10,949	193,494	16,196	19,471	220,778	232,776	52,122	22,111	703,202	241,112	18,335	26,543	32,593	138	1,214

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	P.We'sly M'cca, Labuan & Brunei	Johore	Kedah
22	23	24	25	26	27	28
DRY RUBBER	4,229	10,889	3,229	2,766	1,210	194
WET RUBBER	929	993	332	579	973	175
TOTAL ...	5,158	11,882	3,561	3,345	1,983	369

TABLE III
FOREIGN EXPORTS

PORTS	For month	Jan. to Nov. 1940
29	30	31
Singapore ...	33,366	481,144
Penang ...	11,772	144,466
Port Swettenham.	6,984	75,837
Malacca ...	Nil	1,755
TOTAL ...	52,122	703,202

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	Jan. to Nov. 1940
32	33	34
Malay States ...	31,159	467,788
Straits Settlements	3,208	36,857
MALAYA ...	40,367	504,645

Notes:—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained
2. The production of estates of less than 100 acres is estimated from the formula: Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month. + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [20] − [2] − [3] − [4] − [5] − [9] − [10]. For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Columns (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S and F.M.S., at Singapore on 27th December 1940.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1940.

Locality.	Air Temperature in degrees Fahrenheit: Means of A. Max.	Means of B. Min.	Mean of A and B	Absolute Extremes: Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	Earth Temperature: At 1 foot	At 4 feet	Rainfall: Total. in.	mm.	Most in a day. Amt. in.	Number of days: Precipitation .01 in or more	Precipitation .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more	Bright Sunshine: Total. hrs.	Daily Mean. hrs.	Per cent.
	°F	°F	°F	°F	°F	°F	°F	°F	°F											
Kuala Lumpur Aerodrome Selangor ...	89.3	73.0	81.1	92	71	84	76	83.9	85.3	10.35	262.9	3.04	23	22	7	9	—	148.45	4.95	41
Port Swettenham Aerodrome, Selangor ...	87.4	72.3	79.9	91	70	83	75	84.3	85.9	11.40	289.6	1.88	24	20	5	—	—	178.00	5.93	49
Sitiawan, Perak ...	87.5	73.4	80.5	90	71	83	75	83.0	84.3	10.71	272.0	1.44	25	22	2	—	—	186.35	6.21	52
Ipoh Aerodrome, Perak ...	88.9	72.3	80.6	92	69	85	74	82.4	84.0	17.32	439.9	3.62	28	23	2	—	—	180.60	6.02	50
Temerloh, Pahang ...	88.9	73.2	81.1	93	71	83	75	85.7	87.3	5.13	130.3	0.87	20	14	2	5	—	156.80	5.23	43
Kuala Lipis, Pahang ...	88.3	72.2	80.3	92	70	83	74	83.5	85.1	12.84	326.1	2.32	24	22	—	28	—	160.25	5.34	45
Kuala Pahang, Pahang ...	85.8	73.9	79.9	90	72	81	77	84.8	87.2	11.96	303.8	2.10	17	16	1	—	—	193.95	6.47	54
Kallang Aerodrome, S'pore ...	86.8	75.4	81.1	89	74	81	77	83.2	84.7	7.40	188.0	1.43	19	17	4	—	—	167.20	5.57	46
Bayan Lepas Aerodrome Penang ...	86.2	74.3	80.3	89	72	81	76	84.0	84.9	16.38	416.1	3.77	24	23	5	—	—	200.60	6.69	57
Malacca Town, Malacca ...	84.9	73.9	79.4	89	72	81	76	83.2	85.0	6.38	162.1	1.20	20	18	3	—	—	189.95	6.33	53
Kluang, Johore ...	88.2	71.6	79.9	92	70	82	73	82.0	83.1	10.42	264.7	2.88	23	20	7	13	—	160.30	5.34	45
Mersing, Johore ...	86.7	72.1	79.4	91	70	80	74	82.8	83.4	6.05	153.7	2.04	16	15	1	—	—	196.75	6.56	55
Alor Star, Kedah ...	87.2	73.2	80.2	91	72	78	75	84.8	86.1	6.69	169.9	1.39	23	17	4	5	—	197.15	6.57	55
Kota Bahru, Kelantan ...	85.7	73.6	79.7	90	72	76	75	83.4	84.9	19.68	499.9	6.04	23	19	—	3	—	170.90	5.70	48
Kuala Trengganu, Trengganu	85.4	72.7	79.1	90	71	76	74	82.7	85.2	17.08	433.8	5.55	20	17	2	2	1	182.80	6.09	51
Labuan ...	86.5	76.5	81.5	89	74	85	80	85.0	87.0	14.49	368.0	3.70	23	21	—	—	—	242.35	8.08	68
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	73.5	62.2	67.9	80	61	69	63	72.0	72.7	20.25	514.4	3.80	27	25	1	14	—	122.95	4.10	34
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	70.8	56.3	63.5	76	49	68	60	70.3	70.4	21.32	541.5	2.36	29	27	1	—	—	86.45	2.88	24
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	71.1	59.3	65.2	76	58	67	61	*	*	20.70	525.8	1.92	29	26	—	1	—	94.20	3.14	26

* Not recorded.